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CONTENTS.

Editorial 1095
American Telephone Franchise Conditions..... 1098
Electricity and the Smoke Problem..... 1098
Heavy Thefts of Wire in Mexico..... 1099
Discussion of Municipal Ownership..... 1099
Industrial Education at the General Electric Works..... 1100
Silicon as a Wireless Detector..... 1100
Variable-Speed Induction Motor 1101
Single-Phase Traction for the Erie R. R..... 1101
Current News and Notes..... 1101
The Summer Lane Generating Station of the Birmingham, England, Corporation 1105
Wireless Telephony and Telegraphy..... 1107
The Single-Phase Induction Motor.—I. By Alfred Still..... 1108
Testing Large Alternators 1111
Electrical Ignition in Internal Combustion Engines.—II. By F. W. Springer 1111
Single-Phase Light and Power Work at Centralia, Ill..... 1115
LETTERS TO THE EDITORS:
Sodium as a Conductor. By Francis B. Crocker..... 1116
Wireless Telegraph Receiver. By J. A. Fleming..... 1117
Racial Engineering. By F. V. Henshaw..... 1117
Digest of Current Electrical Literature..... 1117
The Bastian Mercury Lamp..... 1122
New Benjamin Outlet Box Receptacle..... 1123
Soldered Rail Bonds 1123
Electrically-Driven Mine Hoist..... 1124
Electrical Equipment for Iron Mines..... 1124
Flush Receptacle 1124
Experimental Electrical Apparatus 1125
Equipment for Textile Factory..... 1126
The Alsop Process of Ageing Flour..... 1126
Commercial and Industrial Notes..... 1127
General News 1129
Weekly Record of Electrical Patents..... 1135

THE NEW LAMPS.

The discussion on the admirable A. I. E. E. papers of Dr. Steinmetz and Dr. Sharp, abstracted in our issue of last week, brought out a great mass of interesting material. The subject is a most fruitful one and the amount of exact data is so small that every addition to it is a very positive gain. The present situation seems to be that the old carbon lamp is upon the point of being pushed into the background by the group of new lamps which have been developed abroad. That the credit for the revolution belongs on the other side of the water is, as Mr. John W. Howell pointed out, cause for regret. The fact seems to be that there has been in this country a long period of prosperous and complacent standardization which has been grasped by our foreign rivals as the opportunity for systematic and successful research and improvement. In this connection it may be noted that in Germany some important manufacturing industries have in recent years been recognized on the basis of non-standardization expressly to overcome American competition based upon standardization. Be this as it may, the new lamps are already here and although not yet in sufficient production to make a powerful impression on the market, it is clear that the days of the carbon lamp are numbered. The change will perhaps not be very rapid, but it is surely under way. In New York City, for example, consumers are now being supplied by the central station company with tantalum lamps at 35 cents each. We are disposed to think that Dr. Sharp somewhat over-rated the improvements made in the carbon filament. After the pure cellulose filament was fairly established in the art it was rapidly pushed to a highly satisfactory point and there are certainly results obtained from filaments a dozen years ago not markedly inferior to those attainable now. The average lamp has quite certainly been greatly improved, but the best lamps of the early nineties were very good lamps indeed.

Dr. Steinmetz's suggestions as to the importance of the vaporizing point of the filament material aroused interesting discussion. The main question is, of course, at what temperature the solid incandescent body loses its mechanical stability, whether by fusion or evaporation. Some materials like carbon evaporate rather than melt, and it is this evaporization point that determines their stability. The true metals generally melt long before they evaporate. Aluminum, for instance, melts fairly easily and distills with great difficulty. Tungsten and osmium are, chemically speaking, in the borderland between metals and non-metals, and are fusible only with extreme difficulty, if at all. Tantalum, which is far more nearly a typical metal, has a high fusion point, but does actually melt and run. At a certain high temperature the tantalum filament when worked on alternating current is brittle and tends to "fault" as the geologists would say, which is as disastrous to its life as a filament as if it melted or evaporated. Whether this is a normal property at a certain temperature as in the case of zinc, or is due to the effect of slight impurities in the commercial metal or to purely physical causes remains to be seen. The inventor of a tungsten lamp now in course of development for which the astonishing illumination of 20 candles per watt is claimed, maintains that the defect of the

tantalum filament is due to the presence of impurities, and that by reducing tungsten to its pure metallic state, its efficiency as a lamp filament is enormously increased. Both its melting and vaporization points of tungsten are high enough to give splendid efficiency as has already been shown. Up to the present the tungsten filaments are enormously inferior to the carbon ones in smoothness and homogeneity. Under th- microscope they look relatively rough and unfinished, which accounts for the fragility denied by many who make them and asserted by all who handle them. There is no *a priori* reason, however, to expect that it will prove at all an impossible task to make a smooth and homogeneous filament of tungsten or analogous materials.

During the discussion there was evident an inclination to attribute the very great efficiency of tungsten to selective radiation. On the evidence of recent investigations and of general knowledge of radiation there is no reason to believe or to suspect that tungsten departs enough from black body radiation to gain thereby any substantial proportion of its great efficiency. In the first place, it does not belong to the small group of bodies known to have marked selective radiation. The elements have been pretty thoroughly overhauled in the search for such properties. Second, the actual spectrum of incandescent tungsten is not such as to indicate any probability of strong selective action. Only very marked abnormality in the infra-red portion of its spectrum could confer upon tungsten high selective efficiency, and it is hardly to be expected from the distribution of energy in the visible spectrum that such abnormality exists. If it be possible to attain high efficiency in an incandescent body at a temperature below, say, 2,000 C., investigation must cover a group of bodies very different from tungsten, a group which Auer von Welsbach has already raked over pretty carefully. If any American investigator has detected a valuable material which von Welsbach has overlooked, we take off our hats to him—let the eagle scream with patriotic pride. Another recourse may prove to be incandescent gases, already put to good use, of which the radiation is normally highly selective. The mercury arc is a type of such illuminants. The difficulty here seems to be the securing of high efficiency combined with good color. Yet another line of operations is that taken in the flaming arc, in which the discontinuous spectra of refractory compounds are put to use, but this is getting away from the simplicity found in true incandescent lamps. All reports from the tungsten lamp indicate excellent progress in its development, and it certainly looks most promising, particularly for lamps of large candle-power. The main question regarding it turns on, so to speak, the mechanical technique of constructing a homogeneous filament. We understand that considerable improvements in this particular are well under way.

Raise the Standard of Illumination.

We have, as our readers know, persistently urged central station companies to raise the standards of illumination in their respective districts; in other words, get customers to light their residences and places of business better. This does not necessarily mean that the light should be extravagantly used. As our readers also know, we have been among the earliest and most persistent in urging the application of good illuminating engineering to customers' lighting installations, in order that customers may be given the maximum amount of really good illumination and not merely a lot of glare which to some extent defeats the purpose of illumination. We have also endorsed the general movement on the part of the American lamp manufacturers of adhering to the present common wattages of incandescent lamps and raising the candle-power as more efficient lamp filaments are produced, rather than adhering to the same candle-power standards and reducing the wattage. Our ideas are not based on any fine-spun theories of illuminating engineering, but on the fact that the great majority of customers will be better pleased if they can get lamps of higher candle-power for the same power consumption than they will be if they get the same light with some reduction of bills. As to what size of lamp shall be used for any particular case, it is an easy matter for the illuminating engineer to select from the numerous sizes available, and users have by no means confined themselves to the so-called "standard" 16-cp lamp. We are not at all in sympathy with the idea that the amount of artificial illumination common to-day is too great. We have a long distance to go yet in most artificial lighting installations before we arrive at a foot-candle illumination equal to that produced by daylight in rooms well provided with windows. Until we get up to that point there is no cause for worry as to excessive illumination. There is, however, cause for a great deal of serious thought as to how to produce a good intensity of illumination in the lower part of a room without introducing an objectionable amount of glare from the lighting units themselves. It is to this end that the best thought of the illuminating engineer must be directed. Considerable progress has been made in the past few years by the introduction of deep reflectors and the like, but much remains to be done yet, as we are only in the infancy of the art of concealing lamps without wasting light.

Undamped Electrical Oscillations by the Hydrogen Arc.

The *Elektrotechnische Zeitschrift* has recently published an important article by Mr. Valdemar Poulsen, upon a method of producing undamped electric oscillations in wireless telegraphy by the singing hydrogen arc. A direct-current dynamo maintains an arc between carbon electrodes in a chamber containing hydrogen or illuminating gas. The arc is shunted by an oscillation circuit connected with the antenna. By suitable adjustments it is stated that the antenna can be kept in continued oscillation, with a frequency of hundreds of thousands per second. This arrangement permits of a relatively high degree of tuning to be secured in the receiving station apparatus, a limiting range of 1 per cent being claimed as attainable. A rather ingenious device called a "ticker" is described in connection with the receiving circuit, when the singing arc is used at the sending station. The detector is not permanently inserted in the local oscillation circuit, but is applied thereto at successive intervals by the ticker, or automatically-driven contact maker. This enables resonance to build up a strong cumulation current in the receiving circuit, connected inductively with the antenna, and then the detector is thrown into the circuit. By this means the energy thrown into the detector may be the sum of the energies in a number of successive waves. This plan is, of course, better adapted to those wave detectors, which, like coherers, are not cumulative in their action.

The singing arc is not the only means whereby energy may be thrown from a direct-current or alternating-current circuit into an oscillatory circuit, but it promises to be a useful device for this purpose. It enables the antenna to be bowed instead of being plucked at long intervals, to use an analogue derived from the excitation of strings to musical delivery. The bowing of

the antenna enables its power to be maintained continuously, and permits of a real train of waves to be emitted from the mast, or a sustained musical note in the acoustic analogy. Once we have secured sustained oscillations in the wireless telegraph signals, we can expect to obtain sharply selective resonance at the receiver, and, therefore, increased freedom from interference. On the other hand, however, a closer degree of tuning becomes necessary in order to bring any particular pair of correspondents into communication. In other words, it becomes easier to keep other people out, but harder to get the desired correspondent in.

THE SINGLE-PHASE INDUCTION MOTOR.

On page 1108 of this issue is given the first of a series of articles by Mr. Alfred Still dealing with the electromagnetic phenamena of the single-phase induction motor. The author discusses the motor from the viewpoint of the stationary single-phase transformer and for this purpose gives a brief outline of the characteristic behavior of such a transformer. Although the object of the present article is merely to establish the transformer features of the motor and to show in what way flux is produced in electrical space quadrature to the main transformer flux, the article, even when considered alone, is of much value in furnishing a thoroughly logical treatment of the phenomena of the stationary transformer. The author's explanation of the transfer of power from the primary to the secondary circuit and of the losses thereby involved serves to show that even the complex inter-relations between current, magnetomotive force, reluctance, flux and electromotive force may be presented to the reader without confusion by dealing directly with physics without the use of involved mathematical representations. Although it is true that by considering that the core flux depends upon both the primary and secondary currents the equations for determining the performance of the transformer can be correctly derived and properly interpreted, yet it cannot be doubted that the real facts are more clearly presented when the core flux is considered as being dependent solely upon the impressed primary electromotive force modified by the slight voltage drop in the local primary circuit. Moreover, the latter method of treating the interdependence of the flux, current and electromotive force leads at once to the consideration of the electromotive force generated in the secondary coil as the real active factor in forcing the secondary current to flow through the total impedance of the secondary circuit, which treatment is strictly in accord with facts, and is far preferable to the method of developing equations which seem to imply that the primary current is an active factor in determining the value of the secondary current.

THE PRESIDENTIAL ADDRESS TO THE INSTITUTION OF ELECTRICAL ENGINEERS OF GREAT BRITAIN.

In our Digest will be found an abstract of Dr. R. T. Glazebrook's presidential address to the Institution of Electrical Engineers. The address dealt with standardization, both of a national and international character. Allusion was made to the resolution of the Chamber of Delegates at the International Electrical Congress of St. Louis, in regard to the importance of attaining a higher degree of international conformity between the electric standards in universal use. In pursuance of that resolution an international conference of government delegates was held last year at Berlin. It was decided at this conference that the fundamental concrete electric standards should be the mercury ohm and the electrolytically-measured ampere. The cadmium standard cell was to have its e.m.f. assigned by reference to the two fundamental concrete units. It is reported that invitations have been issued to the various governments to appoint delegates to a similar conference to be held at London probably in next October.

The address pointed out a very important condition which usually escapes the attention of engineers, namely, that the determination of standards has to be carried to a considerably higher order of precision than that involved in their industrial applications, in order to reach reliable international decisions as to the values of the concrete standards. Suppose, for example, that voltages are required to be measured in some particular industries, such as lamp-testing, to an accuracy of 0.1 per cent. In order to arrive at a reliable international agreement upon the e.m.f. of a standard cadmium cell, kept for reference in a national laboratory, it is necessary to be able to assign the e.m.f. of a standard cell prepared to standard specifications, to a higher order of accuracy, perhaps 0.01 per cent.

A large share of the abstract is devoted to a consideration of the recent report of the screw-threads and limit-gauges subcommittee of the British standardization committee. The conclusions arrived at by the sub-committee in regard to the limits of tolerance for a running-fit, between a shaft and a hole, are based upon observations in factories where such pieces of machinery are made in large numbers. The results are embodied in a series of curves with diameters of shaft as abscissas, and the tolerance as ordinates. These curves approximate to jagged parabolas, as might be expected from the theory of errors applied to mechanism. In other words, the tolerance increases approximately as the square root of the diameter. If, for instance, a tolerance of 0.1 per cent be assigned for a one-inch shaft, the tolerance would be substantially 0.2 per cent for a four-inch shaft, and 0.3 per cent for a nine-inch shaft. Consequently, it is only necessary to consider shafts one inch in diameter, when discussing the various orders of tolerance. The general law is that a shaft must never exceed its nominal diameter. For first quality work a one-inch shaft may be 0.1 per cent, or 1 mil under-sized; for second quality work 0.2 per cent, or 2 mils; for third quality work, 0.3 per cent, or 3 mils. Extra fine quality work may be 0.05 per cent, or 0.5 mil, below size on the inch shaft. In regard to holes, these must always be larger than the nominal diameter of the corresponding shaft. For first quality 1-inch holes the tolerance is approximately between 0.1 per cent, or 1 mil, and 0.2 per cent, or 2 mils; for second quality, between 0.2 per cent, or 2 mils, and 0.4 per cent, or 4 mils; for third quality, between 0.4 per cent, or 4 mils, and 0.8 per cent, or 8 mils. The range of tolerance for holes is thus greater than the range of tolerance for shafts to fit them, when third quality work is considered; but the range of tolerance is the same for shaft and hole in first and second quality work.

No doubt it is useful to have definite rules for tolerance in fits, so as to determine what shall constitute first, second and third-class work. The rule might have been stated in this instance much more briefly than the abstract seems to imply; but that is a question of detail. There seems, however, to be a danger of standardizing too many things, and too far, in Great Britain. Standards are good, but limits assigned to sizes may hamper manufacturing industry. A world in which every object produced was rigidly limited to standard sizes, would be a world in which improvement would be rendered impossible. It would be a Chinese world of ancestral worship in things if not in persons.

American Telephonic Franchise Conditions.

Mr. Harry P. Nichols, assistant engineer of the New York Bureau of Franchises, has filed his report with the Board of Estimate and Apportionment on the result of the investigation which he has made of telephone conditions throughout the country in cities where two telephone systems are in operation. This investigation was made under the direction of the Board of Estimate in view of the application of the Atlantic Telephone Company for a franchise to operate in this city. After covering in a general way telephone conditions in the various sections of the country, where investigations were made, Mr. Nichols takes up under separate headings the subjects which he thinks should be taken into account when considering a franchise for a second telephone company to operate in New York City.

1. *Measured and Flat Rates.*—Mr. Nichols defines the two methods of charging for telephone service, the flat rate being a fixed charge per month or per year for the use of the telephone, regardless of the number of messages sent; the measured rate, a charge based upon the number of messages used. He states that the rate schedules of the independent companies are almost invariably upon the flat rate plan, concerning which he says "that this system is unfair to many subscribers is universally conceded." It is his belief that the matter of rates and their effect upon the financial prosperity of the company offering them demands the most careful consideration by the city in fixing the terms of a franchise. Referring to the proposed rate schedules of the Atlantic Telephone Company, Mr. Nichols says: "I believe the rates offered have not been carefully prepared, which would seem to indicate that the company has not made an exhaustive study of the cost of equipment and operation upon which to base such rates. No rates are given for private branch exchanges and extension stations, which I believe should be specified in the contract."

2. *Suburban and Long-Distance Rates.*—Mr. Nichols states that from information received in other places he believes the charges for suburban and long-distance service in New York to be too high. He states, however, that from information received it would appear it is the intention of the telephone company to reduce its suburban rates in this city to meet the reduction recently made in the local rates.

3. *Effect of Two Systems upon Operation and Cost to Subscriber.*—Mr. Nichols states that while two telephone systems where tried have resulted in an increase in the number of telephones, with a general improvement of service, and lowering of rates by the old company, that this has been attended by inconvenience to subscribers, and by additional expenses to those who have felt that they must have both telephones in order to get a full service.

4. *Growth and Development of Use.*—Mr. Nichols feels that the effect of competition on the Bell companies has been to create a new ambition on their part to enlarge and develop their system. He states that in 1899 the total number of Bell telephones in operation in this country was less than 500,000, while on January 1, 1906, there were more than 2,530,000 Bell telephones in operation.

5. *Effect of Competition on Rates.*—Mr. Nichols states that many contradictory statements were made in regard to the effect of independent telephone companies on the Bell companies' rates, the independent companies claiming that the effect was to force a general reduction in the Bell rates, and the Bell companies claiming that no reductions were made on account of competition, the rates having been reduced from time to time as the companies' earnings warranted. Mr. Nichols thinks that the independent companies have been in the main responsible for these rate reductions.

6. *Effect of Competition on Efficiency.*—Mr. Nichols thinks that competition has raised the standard of efficiency of telephone service generally.

7. *Automatic System of Telephones.*—The report takes up in detail the subject of automatic telephones. Regarding the application of this information to New York conditions, however, he states as follows: "Several exchanges were visited where the automatic system is in operation. However, no exchange examined is of much use in determining how such a system would apply in New York, in which a number of exchanges will presumably be necessary within each borough. In none of the cities visited was there more than one exchange in operation."

8. *Capitalization of Independent Companies.*—Mr. Nichols points out the danger of over-capitalization and compares the capitalization of the Bell Telephone Company of Buffalo, and the independent companies operating in that territory, i. e., the Frontier Telephone Company and the Rochester Telephone Company, showing that the first is capitalized at $124 per telephone, while the independent companies are capitalized at $288 per telephone. In his conclusions, Mr. Nichol states that in his opinion the telephone companies in New York are doing everything in their power to increase the telephone development of the city; that the service is equal to, if not better than, that of any manually-operated system; and as to rates—although reductions have been made from time to time—he believes that the board should undertake an investigation to ascertain whether the present rates are as fair and as low as they should be. He states that the officers of the New York Telephone Company and the New York & New Jersey Telephone Company have expressed their willingness to co-operate with the board in such an investigation. In closing his report, Mr. Nichols recommends that the board consider the offer of the New York Telephone Company and the New York & New Jersey Telephone Company, as contained in their communication of July 13, 1906, and direct that an examination be made of the property and financial affairs of the companies to ascertain if the amounts offered to the city for the exclusive right to a telephone business are adequate, and if the rates now charged are fair. He also recommends that the Atlantic Telephone Company be requested to present a study for an automatic telephone system in the City of New York of a capacity such as it proposes to install, together with detailed plans of mode of construction and operation. Further, that a detailed statement showing the estimated cost of the proposed installation, operation, maintenance and expected depreciation be submitted, such statement to show the amount of capital necessary to successfully finance the operation, and the extent to which it is proposed to bond the company, should a franchise be secured. That the system of rates for toll business and subscribers' stations, as contained in the proposed form be revised, and that rates for private branch exchanges and extension stations be added.

Electricity and the Smoke Problem.

The twenty-second annual meeting of the Indiana Academy of Science was held in Indianapolis November 30 and December 1. At no previous meeting of the Academy was the interest more manifest. Mr. Robert Hessler, of Logansport, presided and delivered an excellent annual address. The afternoon sessions were given up to meeting of the different sections and the reading and discussion of technical papers on various subjects, principal among which was a paper on "Steps in the Development of a Smokeless City," by Prof. W. F. M. Goss, of Purdue University, and "Experimental Studies of Reinforced Concrete," by Prof. W. K. Hatt, of Purdue University.

Prof. Goss said that the presence of smoke in the cities which are within easy reach of soft coal mines is becoming more serious every year and becomes a source of heavy expense to every citizen. The damages wrought by its presence upon the architectural embellishment of a city, upon the fixtures and furnishings of the homes and upon the apparel of the people; the extensive use of artificial light, which the presence of smoke enforces, the effect of the shutting out of the sunlight and the pollution of the atmosphere, and other impairments are among the prominent nuisances.

Prof. Goss doubted the ability of legislatures to abate the smoke nuisance and said the problem presented many complications. Its solution can only be reached by co-operative action based upon a full understanding of the difficulties to be overcome. He said the source of smoke may be separated into the following groups, each requiring different treatment: 1. Large furnace fires, such as are employed in metallurgical processes. 2. Large boiler plants—those in excess of 500 hp. 3. Small boiler plants and small industrial fires. 4. Domestic fires, and, 5, Locomotive fires.

Prof. Goss recommended the gas-producing process of con-

verting coal into heat and said that its use under a wide range of conditions would result in economy and prevent smoke from all fires which might properly be served by producer gas, and recommended ordinances requiring such use after a reasonable period. The suppression of smoke from fires of large boiler plants by the adoption of a suitable automatic stoker will effect an economy in operation, hence an ordinance requiring such equipment of plants, after due notice, would not be unreasonable. Generally speaking, no economy can result from the application of automatic stokers to small boiler plants, and a requirement that such furnaces use anthracite, coke or other smokeless fuel, would in many cases work hardships and be prohibitive. Therefore, the wisest and most effective course to follow with reference to such fires is to provide a satisfactory substitute, then abolish them. Where such plants are now employed in the production of power they can be rendered unnecessary through the cheaper and more effective distribution of electrical energy. So far as steam from such boilers may at present be used for heating, they can be rendered of no effect through the supply of heat from a central station. Industries should be encouraged to group themselves within a prescribed area, to better accommodate themselves to some reasonable plan of steam distribution or power supply.

"To properly supplant the fires of numerous small boilers now in service it will be required, therefore, that stations be established throughout the business portion of a city, capable of delivering electric current for power and light, steam or hot water for heating, and a limited amount of high-pressure steam for industrial uses; these central plants to be of sufficient size to justify the use of stokers which will make them smokeless.

"When by municipal co-operation these shall have been provided under conditions which will safeguard the interest of all consumers with reference to cost, then it will be in order to prohibit after a proper time the use of soft coal under all boilers in a city except in connection with automatic stokers.

"Instead of individual fires for domestic use a supply of low-priced gas for use in cooking and the distribution from a central station of large capacity, of steam or hot water for domestic heating at about the same cost is recommended. The establishment of centralized heating plants of sufficient size to justify the maintenance of smokeless fires therein, and in sufficient numbers to serve an entire city, constitutes a problem presenting no serious engineering difficulties. The practicability of such heating has been assured.

Locomotives constitute prolific sources of smoke, and prohibitive legislation in American cities has had but little effect in reducing the amount of smoke delivered from locomotive fires. There are but two ways out of the difficulty. The first and simplest is to require steam locomotives operating within smoke limits of a city, to be supplied with smokeless fuel—anthracite or coke—and second the prohibition of the use of steam locomotives and in the substitution of electric locomotives within the smoke limits of a city. The development of either of these plans will involve the establishment of locomotive terminals upon every road outside the smoke limits of a city where smokeless fuel can be had, or an exchange of steam for an electric locomotive. New York and Washington, D. C., are working out and gradually putting such a plan in operation.

"In the working out of a general scheme or plan for the elimination of smoke many difficulties will be met, but all may be met and harmonized by a proper engineering effort to the comfort of the whole people."

Heavy Thefts of Wire in Mexico.

The Mexican Light and Power Company, the Canadian concern which owns the electric lighting plant and street railway system in the city of Mexico and the large electric power transmission plant at Necaxa, state of Puebla, which furnishes the electrical power for operating the properties, estimates that thieves have stolen and carried away more than $100,000 of its copper wire recently. The boldness of these thieves was so great that no part of the transmission lines was safe from their depredations.

The company appealed to the police department to aid it in stopping the robberies. A force of detectives was placed at work upon the cases and as a result a big conspiracy has been unearthed. The first clew was accidentally discovered when a detective happened to notice a small piece of copper wire lying upon the floor of an adobe hut in a squalid part of the town. The investigation which he made on the spot showed that the hut was used to store stolen wire in. Two men were arrested on the charge of being implicated in the thefts. They were convicted and sentenced to eight and twelve years in the penitentiary. The confession of these two men, made after their conviction, led to a number of other arrests. Several junk-shop men were found to be concerned in the conspiracy. It was also discovered that large quantities of the stolen wire were shipped to San Luis Potosi where it was smelted into bars and shipped to the United States to be sold.

On one occasion, several months ago, a mile of copper wire was cut and stolen one night at one point. The company says that it must have required at least ten mules to carry off the booty of the thieves. The fact that the wire was electrified seemed to cause the thieves no inconvenience.

Discussion of Municipal Ownership.

Mr. Arthur Williams, president of the National Electrical Light Association, read an address on "Municipal Ownership" before the Engineering Society of Columbia University, at the University, on November 21. It was an admirable presentation of the data and arguments that have been embodied in previous papers and articles by the author, and included also some interesting new matter. He showed how far the movement had gone in many parts of Europe, but instanced the signs of public indignation and revolt, such as those of the last municipal election in London. As to one of the "crack" European exhibits he remarked: "The beautiful 'fact stories' of European cities, appearing in various magazines, have had not a little to do with the growth of the municipal ownership sentiment in this country. The United States Consular Reports refer to Freiburg, Germany, the cradle of municipal ownership, as a 'model German city.' That city operates the street railways, gas, electric light and water works, the theatre, slaughter house, pawn shop and savings bank, the schools, cemetery and daily newspaper. It also owns vineyards and forests and sells building lots. From the trams, electric light and gas works the receipts last year were $522,820, the expenses $512,591—a difference of $10,229, all that was applicable to taxes, interest, depreciation and sinking fund. The amount would not be sufficient for taxes alone on the American basis, leaving other elements of loss, aggregating fully $350,000 to be made up from general taxation. Curiously, real profits seem to have been made from the supply of water and the operation of the cemetery. From these the profits were $84,755, or 57 per cent of the receipts. In this 'model' city, water to drink and a grave to be buried in are inordinately taxed."

With respect to the conditions at Glasgow, he said:

"Take as another sample of the kind of misstatement abroad in the land, the following, inserted in the daily papers by one of our prominent magazines supposed to be conducted with fair regard for the truth: 'Glasgow owns its own trolleys, earns $1,000,000 a year, carries 57,000,000 people a year at one cent fares, with better public service than we Americans get for 5 cents.' For the ownership of these trolleys the people have paid more than $14,000,000. Instead of $1,000,000 earned the Glasgow officials themselves claim only $248,990, or 1.9 per cent on the investment. Even this small sum would disappear and a large deficit take its place were the tramways treated in Glasgow as the private companies are in our American cities. A year ago the taxes paid aggregated $191,680, or less than 20 cents per capita, compared with $1,200,000, or $1.20 per capita in Brooklyn, and $1,494,552, or $1.50 per capita, paid by the Elevated Railway Company, of Boston.

"Glasgow fares vary according to the distance traveled, from 1 cent to 6 cents. The cent fare is for slightly more than a half mile, or on a straight line, from Thirtieth Street to the Grand Central Station, in New York City. Instead of a cent fare for

all, as might be inferred from this cleverly-worded advertisement, only 30 per cent of the passengers travel this distance—which most Americans walk. We are not told by these 'fact' writers that 90 per cent of all Glasgow's tram traffic is over a maximum —not an average—distance of 2.3 miles, which is less than from the Battery to Fourteenth Street, on Broadway; we are not told that people working below the City Hall, and living in Harlem, would pay—allowing for wage difference—a fare of from 10 to 14 cents, or that, while in Glasgow one can travel a maximum of five miles for six cents, on Manhattan Island, or in Brooklyn, one can travel 18 or 20 miles for five cents; we are not told that under municipal ownership Glasgow has less than 150 miles of tram service, compared with Brooklyn's 600 miles under private ownership; we are not told that the congestion of the city, resulting from the relatively high trams' fares of municipal ownership, caused in 1901 91,205 persons in families of from one to twelve to live in single room tenements, and 194,284 persons in families of from 5 to 12 to live in two rooms; we are not told that, as a result of this congestion, in both 1900 and 1901, outbreaks of the plague occurred; nor are we told that smallpox is so common that more than 600 beds have had to be provided in Glasgow's smallpox hospitals. Few know that Glasgow's death rate for each thousand of her population was 11.2 for dwellers in houses of four or more rooms; that it rose to 21.3 for dwellers in tenements of two rooms, and to the enormous number of 32.3 for those who, through the restrictive policy of municipal ownership, necessarily live in one room tenements."

One point that is not often touched upon or brought out in discussions of this subject, is the political effect. Mr. Williams made the following notes pertinent to that serious consideration: "It has been said that English politics are largely, if not entirely, free from those influences so much in evidence and so greatly feared in the control of our American municipalities; that this difference—this higher degree of English virtue—eliminated all risk politically, of having an enormous number of voters on the payrolls of the city. But the English nature must differ greatly from our own should there ultimately be any marked failure to use the collective voting power of an army of municipal employes to retain, or place, in office the men who control their positions and fix their incomes. That there is no such material difference is shown by several authorities. Take a recent quotation of Mr. William Lloyd Garrison's from *Land Values*, the organ of the Glasgow Single Tax movement: 'We have 15,000 in the employment of the Glasgow Council and every additional piece of municipal extension adds to the number. Many of the workers are organized and are exercising more political power in the return of their own creatures to the council. The best interests of the city are a secondary consideration. In fact, the workers cannot see the city's interest except through their own, while the more vigorous of them work for the return of candidates who will assist them and their friends into corporation jobs.' Prof. Hugo R. Meyer, in a recent article in *Moody's Magazine*, states that some of the most experienced British municipal politicians have expressed a desire that the right to vote be taken from municipal employes, owing to the possibility of municipal politicians bribing municipal employes 'through the payment of fancy wages and the relaxation of discipline.' Turning from British municipal to national politics, the same writer states that every ministry that has held office since 1876 has bribed the employes in the British post office and state telegraph by making concessions which violated the public interests. Sometimes these concessions consisted in the payment of wages not determined by the law of supply and demand; sometimes in the relaxation of discipline and the lowering of the standards of efficiency enforced in private employment; sometimes in unjustifiable promotions.

"The Industrial Freedom League of England describes the enormous aggregation of municipal employes in that country as a 'menace to the common weal,' and as one of the most serious features of municipal trading. On the ground of the pressure they might bring upon members of Parliament, Mr. Gladstone opposed the giving of the right to vote to municipal employes. Lord Salisbury, than whom no one was more familiar with the possibilities of political corruption, objected to the purchase of the National Telephone System owing to the influence that might be exerted on legislation in this enormous increase of State employes. So great was the pressure brought to bear by those in the service of the Government upon a question before the House of Commons on April 30, 1903, that members of both parties appealed to the postmaster-general for protection in the discharge of their duties. About the same time Mr. John Burns, one of England's best friends of labor, went so far as to advocate disfranchisement as the only remedy where electoral pressure of this kind existed.

"At the 1902 election in Birmingham, England, where a bill for the purchase of the tramway system was under consideration, city officials marched bands of municipal employes to the polls and carefully instructed them how to vote. One newspaper correspondent—of the Birmingham *Daily Post*—described how one member of the city council marched a long string of gas meter inspectors to the polls on election day, standing by to see that his voting instructions were carried out. The Lord Provost of Glasgow has publicly declared that to his mind one of the greatest dangers of this municipal ownership movement is the vast army of municipal employes whose operations at the polls might be destructive of the very best in the government of the city.

"Coming nearer home, take our first municipal ferry. During the last primaries statements were prominently made in the newspapers, to the effect that the boats were actually laid off to permit the municipal employes to work at the polls for their political favorites."

Industrial Education at the General Electric Works.

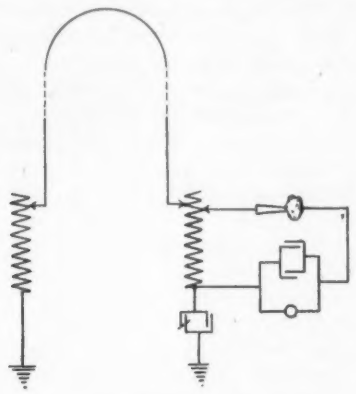
Mr. M. W. Alexander, of the General Electric Company, read an interesting paper upon industrial education from the standpoint of the manufacturer at the Social Education Congress in Boston, December 1. Basing his conclusions upon the experience of the General Electric Company in establishing a practical school at the factory for the training and education of skilled labor, Mr. Alexander emphasized the need of broader knowledge among such employes, and pointed out the limitations of the old apprenticeship system as contrasted with present methods.

The more recent plan of assigning different groups of boys to different departments is to some degree an improvement upon the old system of apprenticing one or more boys to a journeyman worker, but the productive conditions in the departments tend to interfere with the training, inasmuch as the manufacturing department exists primarily for production and not for instruction. Hence, in the General Electric works it was decided to actually set apart a space for instructive work, and the results of the first five years' operation are most encouraging, as far as it is possible to see them. For the training of machinists 10,000 sq. ft. of floor space have been set aside with 105 representative machine tools, all the work done being of a commercial nature. Embryo pattern makers have 1,000 sq. ft. of machinery and tool space assigned. After two years in the machine school, two years were spent in a variety of work in different shop departments, and the result is a workman of trained skill and intelligence. Mr. Alexander closed by urging the co-operation of expert educators in this most important work of supplying trained labor to American industries.

Silicon as a Wireless Detector

A patent issued to Mr. G. W. Packard on November 20, covers the use of the substance silicon as a means for receiving intelligence communicated by electric waves. The silicon is used either in the massive amorphous or graphitic solid form. It is pressed into good electrical contact between two good conductors, such as copper. The device is termed a "thermo-electric regenerative detector." The energy of the received oscillations is converted into heat at the high-resistance junction of the element having high thermo-electromotive force with the low resistance or metallic element, the amount of heat and consequent temperature

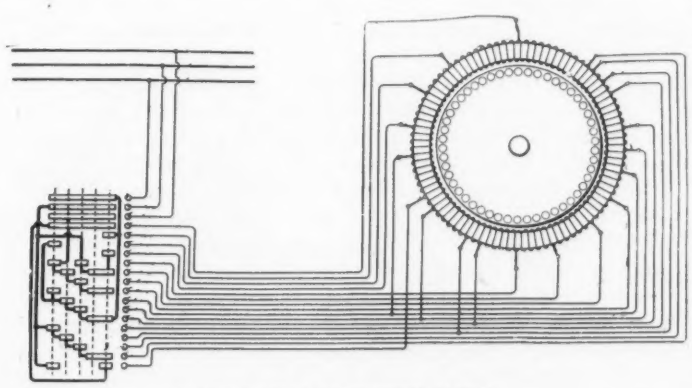
rise being proportional to the square of the current and the resistance, according to the well-known law of Joule. This heat energy is then regenerated or converted into a direct electric current. The inventor states that he has been able to convert upward of 10 per cent of the energy of the oscillations into direct-current energy.



SILICON WIRELESS DETECTOR.

Variable-Speed Induction Motor.

The accompanying illustration shows a method of controlling the speed of an induction motor, as disclosed in a patent issued November 6 to Mr. Marius Latour. The machine is provided with a squirrel-cage rotor secondary and with a Gramme-ring stator primary. The primary winding is arranged so that it may produce either four or six poles. At starting there are six complete poles; two of the poles are then omitted and the other four are gradually separated until they cover the whole periphery. Thus the terminal connections of the primary winding are gradually shifted in passing from one number of poles to another, so that a plurality of speeds are obtained intermediate the speeds which are obtained when the motor is connected first for one and then for another number of poles.



VARIABLE-SPEED INDUCTION MOTOR.

Single-Phase Traction for the Erie R. R.

As was noted on page 1030 of our issue for December 1, the Erie Railroad Company is hurrying to completion the electrification of its Rochester division. A brief outline of the equipment being installed was given in our issue for August 25. It is an interesting fact that the Erie will have the distinction of being the first steam railroad to employ single-phase cars operated by the multiple-unit system instead of using locomotives like the New York, New Haven & Hartford Railroad.

The single sub-station from which all of the power will be received from Niagara, which is located at Avon, N. Y., about 18 miles from Rochester, and 15 miles from Mt. Morris, is now practically completed and the electrical apparatus which it is to contain is being shipped by the Westinghouse Electric & Manufacturing Company. The machinery consists of three 750-kw transformers of the oil-insulated, water-cooled type, transforming the 60,000-volt, three-phase current to 11,000-volt, single-phase current, which is to be fed directly to the catenary trolley wires. The usual accessory apparatus is also supplied, such as bus-bars, oil switches, choke coils and lightning arrester apparatus, together with the necessary pumps and piping for properly handling the insulating oil and cooling water into the transformers.

The trolley and messenger wires are supported by the bracket-type of overhead pole construction. The poles are of heavy chestnut, averaging 8 in. in diameter at the top. The brackets consist of steel T-bars 10 ft. long, supported near the outer ends by two truss rods reaching to the top of the pole, to which they are fastened by a pole clamp designed expressly for this heavy work. Upon the outer end of each bracket is mounted a heavy triple petticoat porcelain insulator, supported upon a malleable-iron pin bolted to the bracket. The insulator in turn supports the messenger cable.

Difficult problems were encountered at Avon and Rochester in supporting these trolley wires over the tracks through the railroad yards, and a new style of overhead span wire construction was designed to overcome the difficulty of carrying such heavy trolley construction through a railroad yard where it is impossible to place poles between tracks. In other places it was found necessary to resort to steel bridges to accomplish this end, but the system of "Tripartite" steel poles and double spans adopted is believed to be fully as effective a type of construction as the former, as it meets all the conditions, is far cheaper and much quicker to erect.

Each car will be equipped with four 100-hp motors, one on each axle, in addition to a transformer and the electro-pneumatic system of multiple-unit train control. The trolleys will be of the pneumatically-operated pantograph type.

The engineers of the above-mentioned work, Westinghouse, Church, Kerr & Co. have been authorized to proceed at once with estimates for the complete electrification of the entire Rochester division between Rochester and Corning, and work upon this is now being actively carried on.

CURRENT NEWS AND NOTES.

ERRATUM.—By a printer's error, in the article on "Electric Steel," on page 1026, of the issue of last week, Dr. Day is quoted as having said that the process to which the article relates "requires little in order to make it perfect." What Dr. Day did say was that an article in the Chicago *Inter-Ocean*, relating to the process, "required little in order to make it perfect."

SINGLE-PHASE WORK AT CENTRALIA, ILL.—The author of the article on page 1115 of this issue, on "Single-Phase Light and Power Work at Centralia, Ill.", requests us to make a correction in the price of coal as there given, but as the form containing the article had gone to press we make the correction by means of this note. On the third line from the top of page 1116 "76 cents per ton at the power house" should be substituted for "50 cents per ton," making the line read: "boilers cost only about 76 cents per ton at the power house, the type of steam ma"-

A. S. M. E.—The American Society of Mechanical Engineers is holding its annual meeting in New York City this week, with headquarters at the Edison Auditorium. An excellent programme has been provided, including a classical paper by President Taylor on "The Art of Cutting Metals." The entertainment features include a reception at Sherry's on Thursday evening, an excursion the same day to the Port Morris power house of the New York Central Railroad, a trip on Friday to the Sandy Hook proving ground to witness the disappearing gun in action, the Automobile Show at the Grand Central Palace, and the Cahill Telharmonium plant of the New York Electric Music Company. The new engineering building has also been a center of attraction during the week. The attendance has been large.

ILLUMINATING ENGINEERING SOCIETY.—The monthly meeting of the Illuminating Engineering Society will be held in the Edison Auditorium, 44 West Twenty-seventh Street, New York City, on Friday, December 14, at 8 o'clock. A paper will be presented by Dr. C. P. Steinmetz, the title of which is to be announced later.

CENTRAL STATION EXHIBIT ROOMS.—The Milwaukee Electric Railway & Light Company has opened up some very handsome exhibit rooms for its electric lighting department in its fine new Public Service Building, which was recently completed. Among other things, a dining-room has been fitted up with Flemish oak furniture and exquisitely illuminated with electric light. It is of course provided with all the new dining-room electric cooking conveniences.

VICTORIA FALLS POWER.—The long-discussed scheme of harnessing the Victoria Falls of the Zambesi River will, according to a special dispatch from Berlin, be started immediately with united British and German capital. When the works are completed electric power will be supplied to the industries of Rhodesia and the Transvaal, including the Rand. The British have the predominating interest in the scheme and will control it. The Kaiser is reported to have expressed his pleasure at the initiation of this project.

CURIE SCHOLARSHIPS.—A special dispatch from Paris states that Mr. Andrew Carnegie has just informed Dr. Liard, vice-rector of the Academy, that he will give to the University of Paris a sum that will produce an income of $2,500. This income is to be used to pay for scholarships for research in the natural philosophy laboratory, which was recently created for the late Prof. Curie. In accordance with Mr. Carnegie's wishes, he desiring that Mme. Curie be associated with the scholarships, they will be named Bourses des Curie. They will be open to students of all nationalities.

LIFE OF TANTALUM LAMPS ON ALTERNATING-CURRENT CIRCUITS.—During a discussion on a paper by Mr. James Swinburne "Indoor Illuminants," read November 14 before the Association of Engineers-in-Charge at St. Bride's Institute, London, Mr. Lee mentioned that tantalum lamps were "running quite comfortably (600 hours and still going) on the County of London Company's frequency, which is 50 cycles, although the makers hitherto have declined to guarantee their durability on alternating-current circuits." This statement is interesting in view of the fact that in this country the tantalum lamp is considered to be distinctly a direct-current lamp.

CENTRAL STATION LIST.—Some idea of the growth of the American electric lighting industry may be formed from the fact that the recent issue of the Central Station List includes about 100 new companies not noted in the previous half-yearly number. There are now over 390 pages of closely-printed station data, containing reports of more than 5,000 plants. It is also interesting to note that over 2,300 of the companies carry a line of electrical supplies, as an adjunct to the sale in electrical energy for light and power, besides dealing in steam for heating, ice, gas, etc. To bring the list up to date 2,600 of the reports required changes in the data, owing to increases of capacity, etc.

CASSIER'S MAGAZINE has been purchased by Mr. Henry Harrison Suplee, for many years the technical editor of *Engineering Magazine*, and Mr. James Van Vorst Colwell, recently works manager for the C. W. Hunt Company, and the publication will be continued as heretofore by the Cassier Magazine Company at No. 3 West Twenty-ninth Street, New York. The first issue of the magazine under the new management will be the January number. The editorial conduct of the magazine will be in the hands of Mr. Suplee, who brings to this work a wide experience both in the practice of mechanical engineering and of technical journalism, and who has an unusually wide acquaintance with engineering leaders, professional and industrial, in this country and in Europe. The business department of the journal will be conducted by Mr. Colwell.

A NEW SUBMARINE.—Mr. John P. Holland, of Newark, N. J., the well-known inventor of electric submarine boats, spoke last week in a lecture before the La Salle Society in Newark in regard to a submarine craft on which he is at work and which is designed to disable instead of destroy war ships. If it proves successful he believes disarmament and not annihilation will be the object in warfare. "This boat on which I am at work," he said, "will be the real new thing in submarines. It will be the chief instrument in doing away with wars. It will not go forth to destroy, but to cripple or disable all that it attacks. It will put a boat out of commission without, I hope, the loss of a single life. This would save thousands of lives such as were lost in the Russo-Japanese war. I believe the new boat will startle the world."

POWER FOR JAPAN.—Americans are interested in a large new power enterprise in Japan. Briefly stated, the purpose of the project is to develop the water power from a mountain lake near Kyoto, an important city close to Osaka. Both cities are great cotton manufacturing centers. Osaka is an important port as well. The lake lies at a great elevation above the sea. The plan is to bring the water by means of a tunnel through a mountain, down to a level several hundred feet beneath the lake. The water will be dropped into great concrete penstocks and turned on to turbine wheels driving generators. Power sufficient to operate a great many cotton mills and for the electric railways and light plants for the surrounding cities will be generated. Three years ago C. H. Baker, who built the Snoqualmie Falls electric power plant, visited Japan in search of just such a concession as has been awarded to Mr. W. E. Guerin and his associates. There is already a large demand for electrical energy in the vicinity.

CONTROL OF CORPORATIONS.—In his message to Congress, President Roosevelt recommends currency reform, inheritance and income taxes, and increased Government control over corporations; also giving railroads the right to combine under sanction of the Interstate Commerce Commission. He says that Congress has taken long strides as to corporation control and "it may be best to wait until the new laws have been in operation for a number of months before endeavoring to increase their scope," but in his judgment it will be necessary to enlarge the powers of the Interstate Commerce Commission over the railroads, and by a system of licenses, or otherwise, to give the Federal Government a more complete control over interstate companies of all kinds, so as to prevent overcapitalization and compel disclosure by each big corporation of its stockholders. He declares that the new rate law has "rather amusingly falsified" the predictions of those who asserted that it would ruin the railroads and accomplish nothing, and he points to the big earnings, the increased dividends and the reduced rate schedules. He lays down the principle that "the Government should not conduct the business of the nation, but that it should exercise such supervision as will insure its being conducted in the interest of the nation."

TROLLEY FOR DAMASCUS.—Damascus is the scene of a new electrical enterprise. After the rejection of a similar scheme for Aleppo in favor of the present one, a concession was obtained by a Turkish functionary, and made over to the Société Impériale Ottomane des Tramways, d'Eclairage et de Forse Electriques de Damas. It has a capital of $1,200,000, of which $800,000 is held by the Société Générale de Chemins de fer Economiques, the Société Générale Belge d'Entreprises Electriques and the Compagnie de Railways et d'Electricité. The terms of the concession give a monopoly of electric traction, light and power, a virtual monopoly of electrical appliances, a right to establish agencies elsewhere and a telephone service, should such be necessary. The company is under contract with the municipality to light certain parts of the town, and to repave the streets where the tramway runs. Electrical power of 900 kw is derived from the falls of the River Barada at Et Tekiye, 22 miles from Damascus. For the present 3½ miles of trolley, connecting the suburbs of Maidan and Salhiyeh, are being built.

TELEPHONY IN NEW YORK CITY.—The Atlantic Telephone Company has made a new offer to the Board of Estimate for "independent" telephone service throughout the city at flat rates. Three different propositions were presented as follows: "An unlimited service covering all the boroughs of New York at $120 a year; an unlimited residence service covering all the boroughs at $60 a year; for subscribers who do not wish to contract to the above prices, a charge of five cents a message between all boroughs, the subscriber to guarantee a minimum business of $30 a year.

ROYAL SOCIETY MEDALS.—The following Royal Society's médals have this year been adjudicated by the president and council as follows: The Rumford medal to Professor Hugh Longbourne Callendar for his experimental work on heat; a royal medal to Professor Alfred George Greenhill for his contributions to mathematics, especially the elliptic functions and their applications; the Davy medal to Professor Rudolf Fittig for his investigations in chemistry; the Hughes medal to Mrs. W. E. Ayrton for her experimental investigations on the electric arc and also upon sand ripples. The King has been graciously pleased to approve of the award of the royal medals.

MUNICIPAL FAILURE IN EASTON.—As a result of repeated protests by the citizens of Easton about the inefficient street lighting service given by the municipal plant, Mayor March has, according to a newspaper dispatch, directed the City Council to either take action to obtain good service or hand over the street lighting to a private corporation. He declares the present service is "dangerous from the police point of view and dangerous and unbearable from the point of view of the citizen." It is stated that there has long been complaint about the service, but the City Council has not been able under the conditions of the municipal operation of the plant to give the city a service which is in any way satisfactory.

POULSEN WIRELESS.—A special cable dispatch from Copenhagen, Denmark, says: "That Lord Armstrong contemplates interesting himself in wireless telegraphy in America is indicated by the announcement that he has purchased for $500,000 the patent rights for America of the wireless telegraph system invented by Waldemar Poulsen, Danish engineer. Sigurd Bojesen, a Danish resident of London, is associated in the enterprise with Lord Armstrong. The chief feature of Poulsen's wireless system is said to be the substitution of a continuous flow of energy to the receiver for the old method of intermittent sparks, and it is asserted that the system solves the vexed question of interference between stations working simultaneously." It is said that messages have been sent from Copenhagen to Newcastle, the home of Lord Armstrong, with 2 hp of electricity, the distance being 500 miles.

GRANT OF FRANCHISES.—President Peters, of the Long Island Railroad, in discussing the proposed terms of the franchise his road seeks from the city, told the plan and contract committee of the Rapid Transit Commission that he was opposed to paying a yearly rental for the privileges he sought. He would prefer to pay a lump sum for the franchises. President Orr, of the commission said he was very much opposed to the city granting franchises in that manner. It would be imposisble at this time to make a fair estimate of what the privileges were worth. It is the rule now to grant franchises for reasonable compensation and the only fair means of gauging an adequate rental was to follow the rule which the board has used in dealing with the Pennsylvania Railroad; that is, so much per running foot of city street occupied; this amount to be paid for ten years, an increase for the succeeding fifteen years and a readjustment of compensation to be made every twenty-five years thereafter during the life of the franchise. In this way the rights of both parties would be safeguarded, and neither could take advantage of the other.

ANOTHER MONTHLY BULLETIN.—The Potomac Electric Power Company, of Washington, is to join the number of electric public service companies which find it to their advantage to issue a monthly bulletin. This bulletin, the first number of which is to be dated next January, is to be called the *Pepco News*, and is to be prepared under the direction and supervision of Mr. E. S. Marlow, the treasurer of the Potomac Company. The plans for the publication have been well advanced and these indicate that each monthly issue will be exceedingly attractive in appearance. It will be a sixteen-page paper of magazine form, and, printed in several colors, will be unusually rich in illustration. The cuts and the text matter will convey to its readers information of new things electrical, and data as to the manner in which electricity may be applied to advantage in the home, in business, or in manufacturing.

THE LONDON ELECTION.—In an editorial article on the recent decisive election, with its overwhelming vote against municipal ownership, the London *Times* says: "It will be necessary to remember, in order to guard against disappointment, that many of the most objectionable of the municipal undertakings which have now been so emphatically condemned are to some extent in the nature of commitments, and that their immediate abandonment may not be entirely practicable; a condition which, whenever or wherever it may exist, is certain to be diligently improved by any remaining Progressives, and used, to the fullest possible extent, as an argument by which it may be possible to lead their new colleagues astray. In every case in which the new councils can be induced even apparently to endorse or to continue the policy of their predecessors, or to accept the burdens which these predecessors have laid upon them, it will become possible for their opponents to invite a comparison between the professions and the performances of the reformers, and to point out that the public burdens have not been appreciably diminished by the change. It is possible to hope that the lessons of this week will be laid to heart in the future; and that the government of London may in time be brought into harmony with the desires and opinions of the great bulk of those who reside within its boundaries. The County Council has lately provided a few object lessons of a very striking character, such as the Thames steamers and the desire to engage in vast electrical undertakings, and these, we may fairly hope, will make upon the electors an impression of more than a fleeting or temporary character."

RECONSTRUCTING CORPORATIONS.—Judge Grosscup, the well-known occupant of the Federal bench in Chicago, spoke at Kansas City last week on the necessity of improving the structure of American corporate life. "The reconstructed corporation should have no place in it for those schemes of spoliation that, within or without, plunder the people whose capital has created it, and whose patronage must support it. In the reconstructed corporation the securities issued must be related in some way to the values actually put in. In the reconstructed corporation not only must the officers be trustees of the stockholders, held to the strict accountability to which individual trustees are now held, and denied the privilege as individual trustees are now denied, of making profit out of their trust; but the administration of the trust, as in the case of individual trustees, must be constantly kept under the eye of some tribunal of the Government. And in the reconstructed corporation tangible inducements ought to be given to the workmen, the clerk, the employe of every kind, to obtain proprietorship. I shall not attempt to point out in detail how existing corporations shall be brought into the new régime. Considering, however, that existing corporations depend largely on the public from time to time to take their securities, especially their bonded securities, the probability is that, as a matter of self-interest—in many cases of life or death—existing corporations would be compelled to conform their organization to the reconstructed organization prescribed by the Government, for otherwise they would brand themselves as suspects. Then, too, within the respective powers of the nation and the States to prescribe the kind of collateral that banks, insurance companies, and savings institutions shall not take for loans, the nation and States could exert a leverage toward the new order of things that could not be resisted, for nearly every great corporation is a heavy borrower from these financial reservoirs of the people's wealth."

NORTHWESTERN ELECTRICAL ASSOCIATION.—The Northwestern Electrical Association will hold its annual meeting for 1907 at Chicago January 16, 17 and 18, at the Coliseum, where the Electrical Show will be in progress at that time. Mr. B. C. Adams, of the Lincoln (Neb.) Gas and Electric Light Company, is secretary, Mr. Adams having moved from Madison, Wis., during the year.

PARIS MESSENGERS.—It is announced from France that the latest addition to the conveniences of modern life in Paris is the introduction of a messenger boy service on the lines of those established in New York, London and other great cities. Bureaus are about to be established in the principal quarters of Paris, in electrical communication with the residences of subscribers. Each subscriber will have an electric apparatus with a dial divided into five sections on which are inscribed "messenger," "cyclist," "police," "fire brigade" and "doctor."

MANCHESTER MEETINGS.—The Manchester section of the Institution of Electrical Engineers has planned a series of interesting sessions and papers for the winter of 1906-7. The authors include Messrs. T. L. Miller, Miles Walker, J. H. C. Brooking, W. Cramp, G. W. Worrall, C. E. Douglas, L. Foster, L. G. Hunt, A. P. Wood and C. F. Smith. The meetings will be held in the Physics Laboratory of the University of Manchester. The secretary of the section is Mr. H. W. Wilson, 19 Brazennose Street, Manchester, England, and Mr. T. L. Miller is its chairman.

ACTIVITY IN OHIO.—The report of the secretary of state for Ohio the past year shows that seventy-four telephone and telegraph companies were incorporated with an aggregate capital stock of $1,257,075, while existing companies increased their capital stock $3,831,700. As most of the new companies are in the telephone line, as well as in the increases, some idea of the amount of money going into the industry may be had from this report. Telephone companies pay taxes upon an annual income of $8,000,000. According to the report of the secretary of state for the past year, nineteen electric light and power companies were incorporated, with a capital stock of $929,000. The statistics do not include electric railway systems, which would probably more than equal the others all told, as to new capitalization.

WASHINGTON AND STEAM.—The Pennsylvania and the Baltimore & Ohio Railroads have informed the Commissioners of the District of Columbia that they cannot substitute electric motors for steam locomotives within the District. The Commissioners requested that this be done from the time the new union station is in use. President Cassatt has put his action on the ground that the public would be incommoded by the necessity of an extra stop to change from one motive power to another at the border of the District. He says it would be "seriously objectionable in view of the high-speed service which we propose to establish between Washington and the North." The Baltimore & Ohio declares that the proposed plan would be impracticable and unsafe. President MacFarland, of the District Commissioners, said he would ask his colleagues to bring the matter to the attention of Congress, as the action of the railroads meant a "definite postponement of this very desirable action unless Congress should require it of them by law."

NURSING NIAGARA.—During the recent hearings with regard to the granting of permits for the use of Niagara water, Secretary Taft had one or two tilts with the gentlemen who voiced popular objections, and criticised their language as "hysterical." During his remarks, Secretary Taft criticised the circular issued by the American Civic Association. He took particular exception to the statement that the War Department intended to divert from the Niagara River a volume of water equaling the outflow of the Potomac, Hudson and Delaware rivers at their mouths. He declared that that statement was not true, and that the fact was that it was inended to divert only about 6.8 or 10 per cent. of the total volume of the Niagara River. "I do not think," said he, "that public opinion solicited on such arguments amounts to very much." Mr. McFarland, who is the author of the circulars, defended them by saying that his statement about the three rivers mentioned referred only to the fresh water outflow, and not that affected by the tides. As a matter of fact, much of the talk about "destroying Niagara," is wildly loose, reckless and inaccurate, and well deserves the pointed censure of it by Mr. Taft. He has announced that pending the result of the negotiations between this country and Great Britain, he will grant no more permits for utilizing the American side of the Niagara Falls for power purposes. The negotiations which are now pending look to a treaty to limit the diversion of water from Niagara River.

WHAT M. O. CAN DO.—With regard to the recent election in London, when the citizens went so fiercely against municipal ownership, the New York *Evening Post* says: "Now, what was the cause of this marked change of heart in London voters? Tax-bills. The management of the affairs of the boroughs was becoming fearfully extravagant. Lavish borrowing was the order of the day, to keep up with the costly application of socialistic theories. The rates were going up, and were bound to go much higher, unless a halt was called; and the rate-payers did, in the election, imperatively call a halt. There were also scandals in some of the boroughs. Their exposure had something to do with the revulsion against the Progressives. An official inquiry was made, on the demand of aggrieved rate-payers, into the administration of the Poor Law in Poplar. This is a metropolitan union signalized by Mr. Charles Booth ten years ago as the least pauperized of the ten which he grouped as "specially devoted to manufacture and trade." To-day it is the most pauperized, the investigation showed; while it has incurred so great a debt that there is now no sufficient security for further loans. How this unhappy change was brought about, is shown in detail by the report of the chief inspector of the Local Government Board, Mr. J. S. Davy. It has just been issued as a Blue Book. The story is a depressing one of bad management, careless waste and demoralizing use of the public funds in a way to extend the very evils to be checked. It is the more significant in that Mr. Crooks, the well-known labor M. P., was one of the Poplar guardians. Thus it was under the most Progressive auspices that the paupers have increased four-fold, while the rates jumped up almost as ominously."

TROLLEY TUNNEL TERMINAL.—The New Jersey trolley tunnels will have their terminal in New York city at Dey, Fulton and Cortlandt Streets, where a huge 22-story station building is now being rapidly constructed. It will also have space for 4,000 offices. Beneath will be the terminal station of the Hudson and Manhattan Railroad Company, which will operate tunnels now being built under the Hudson River. Passengers will enter upon the street floor and pass down into the station by means of stairways, inclined planes and elevators. The first floor below the sidewalk will be known as the concourse, with waiting rooms and ticket booths. Below this will be the train platforms. There will be five tracks running between six platforms. Passengers will pass out of a train just arrived on to an unloading platform, the side doors of the cars permitting them to discharge their passengers in a comparatively few seconds time. The cars will be of steel and capable of seating fifty persons each. Of the four trolley tunnels now being built under the North River, the two down-town are about three-fifths completed and the uptown completed to Sixth Avenue, Manhattan. The two southern tunnels extend from Cortlandt and Fulton Streets, Manhattan, to Montgomery Street, Jersey City. There will be a transverse tunnel in Jersey City extending along shore beneath the tracks of the Pennsylvania, Erie and Lackawanna railroads, with entrances at each station. The northerly tunnels will extend from Fifteenth Street, Jersey City, to Morton Street, New York. The tubes will continue under Morton, Greenwich and Christopher streets to Sixth Avenue, thence up to the site of the Manhattan Theatre and the uptown terminal. At Christopher Street and Sixth Avenue a branch will be continued eastward under Ninth Street, where it will connect with the Interborough Subway. Power for the operation of tunnel cars and the heating and lighting of the terminals will be supplied from Jersey City. A central power house is now being built there on the block bounded by Washington, Bay, First and Greene Streets. It will be completed about June 1, 1907.

The Summer Lane Generating Station of the Birmingham (England) Corporation.

THE new Summer Lane station of the Birmingham (England) Corporation Electric Supply Department, which was opened on October 10, forms the most important element in the supply system of that city. The corporation owns a plant at Dale End, which contains several small generating units of an early pattern aggregating about 1,500 kw, and a station at Water Street having a total capacity of 3,476 kw, supplying electricity to a 220-440-volt network. In order to municipalize the city railways and to place the city in position adequately to meet the demands for energy for motors and lamps, a scheme was decided upon involving the erection of a large generating station for the supply of both direct and alternating current, the latter being transmitted to a series of sub-stations and there distributed locally as direct current. The new generating station was centrally located in Summer Lane adjoining the Birmingham and Fazeley Canal. There are four sub-stations situated as follows: Camden Street, Dudley Road; Upper Trinity Street, Bordesley; Court Road, Balsall; and Scholefield Street, Saltley.

The generating station has been designed to deal with four classes of supply, as follows:

1. A direct-current supply for private lamps and motors in the neighborhood of the station, at pressures of 220 and 440 volts.

2. A direct-current supply, through a system of trunk mains, to the distributing switchboards at Dale End and Water Street generating stations at a pressure of 440 volts, in order to deal with the increase in the demand for private lamp and motor supply in these districts.

3. A direct-current supply to the electric railways within a radius of about two miles from the generating station, at a pressure of 550 volts.

4. A three-phase alternating-current supply to the sub-stations which have been erected in the outlying districts of the city, at a pressure of 5,000 volts.

The plant capacity for which accommodation has been provided is as follows: Direct-current generators, 7,000 kw, first equipment; 13,000 kw, ultimate capacity. Alternating-current generators, 4,500 kw, first equipment; 13,500 kw, ultimate capacity.

The engines for the direct-current and alternating-current sets are strictly in duplicate, the only variation being a slightly higher rotative speed in the alternating-current set to correspond to 25 alternations per second. The direct-current sets run at 160 r.p.m., and the alternating-current sets at 166⅔ r.p.m. The engines are of the Belliss high-speed, enclosed, triple-expansion, self-lubricating type, designed for operating with steam at 180 lb. pressure and superheated 100 to 150° F. Four of the engines operate 1,500-kw Dick-Kerr direct-current generators, while two operate British Westinghouse alternating-current generators of the same capacity. Three engines drive 500-kw British Westinghouse alternators and two 180-hp engines drive General Electric exciting dynamos. There have also been installed two 500-kw Parsons steam turbines driving direct-current generators giving a pressure of from 460 to 520 volts. These turbines, together with the two exciter engines, are coupled to a surface condenser, and a set of motor-driven air pumps. Each main engine is provided with its own surface condensing plant arranged alongside the engine.

The large direct-current generators are 16-pole, compound-wound machines; it is intended to use them as ordinary shunt machines for the lighting supply, and as compound machines for the traction supply, the necessary alterations in the connections being effected at the switchboard. The alternators are standard engine-type, revolving-field, three-phase machines geenrating at 5,000 volts.

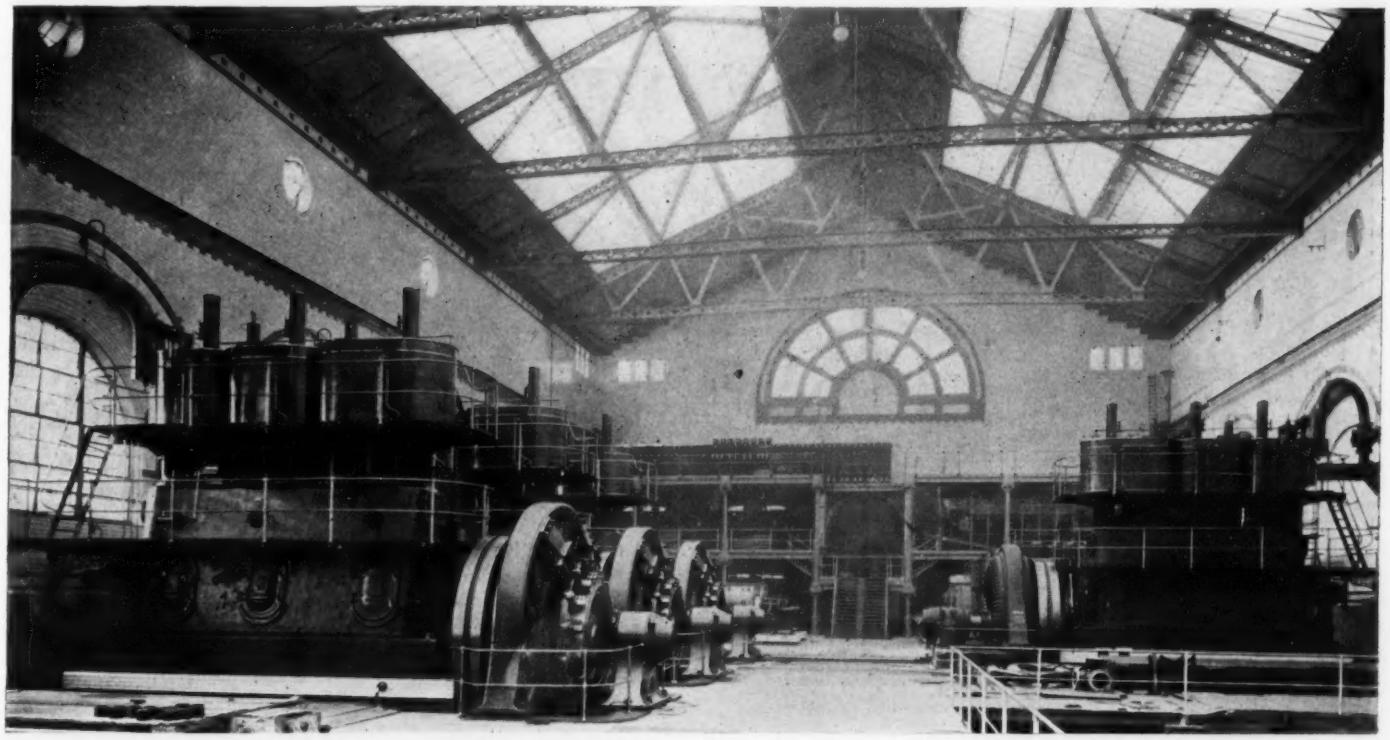


FIG. 1.—GENERAL VIEW OF SUMMER LANE STATION, BIRMINGHAM.

Two 100-kw Phoenix motor-driven balancers are used for dealing with the out-of-balance current on the local lighting network, while two 25-kw Phoenix motor-driven, three-wire boosters are installed to give the necessary increase in pressure on the trunk main supply to the Dale End and Water Street generating stations. Each booster, which is capable of dealing with 2,500 amp. and will supply 10 volts either positive or negative, as may be required, consists of a motor and two boosters for dealing separately with each side of the three-wire network. A 200-kw Phoenix motor-generator is installed for giving a direct-current supply to the railway system from the direct-current lighting bus-bars during light load at night after the main traffic has ceased.

It is proposed to install a large storage battery with reversible booster for equalizing the load upon the direct-current generators used for supplying electricity to the railways, and also a 200-kw rotary converter to enable the alternating-current supply to be coupled to the direct-current supply, in order to avoid running the steam plant on both classes at times of light load.

One of the features of the station is the switch gear for handling the various generators and feeders. It is believed that the direct-current switch gear is the largest in England. It is arranged to control 12 generators, 9 auxiliary machines, a storage battery, 16 traction feeders, 16 three-wire local lighting feeders and 16 three-wire trunk feeders.

Each of the main 1,500-kw generators is connected to its panel by nine cables: three positives, three equalizers or lighting negatives and three traction negatives. The main positive lead from each generator passes through a carbon break circuit-breaker, without overload but with reverse current attachment, also through a 5,000-amp. ammeter shunt with laminations in a vertical plane to give maximum cooling effect, and with ends on the same horizontal line to minimize temperature errors. The shunts are all adjusted to the same drop at full load, so that all ammeters become essentially milli-voltmeters, and can be calibrated as such. All indicating instruments throughout this switch gear are of the vertical edgewise type and are mounted at three elevations according to other requirements of the panels.

No voltmeters are used across any generators, or in general for comparing the voltage of any unit with that of the bars or of any other unit. Each main bus-bar has its voltmeter or meters of the illuminated-dial sector type with limited open scales and with running index. Each machine is paralleled on the zero method by a vertical illuminated dial voltmeter connected across the last switch closed in paralleling. To take care of the case of a dead machine, the voltmeter scale runs up to 600 volts one way, but to obtain greater sensitiveness at zero a spring-restored key is provided for cutting out nine-tenths of the voltmeter resistance, thus multiplying the deflections ten times. In general the main bus-bar sector type voltmeters, mentioned above, are suspended overhead where they may be readily seen from any rheostat handle which may affect their readings.

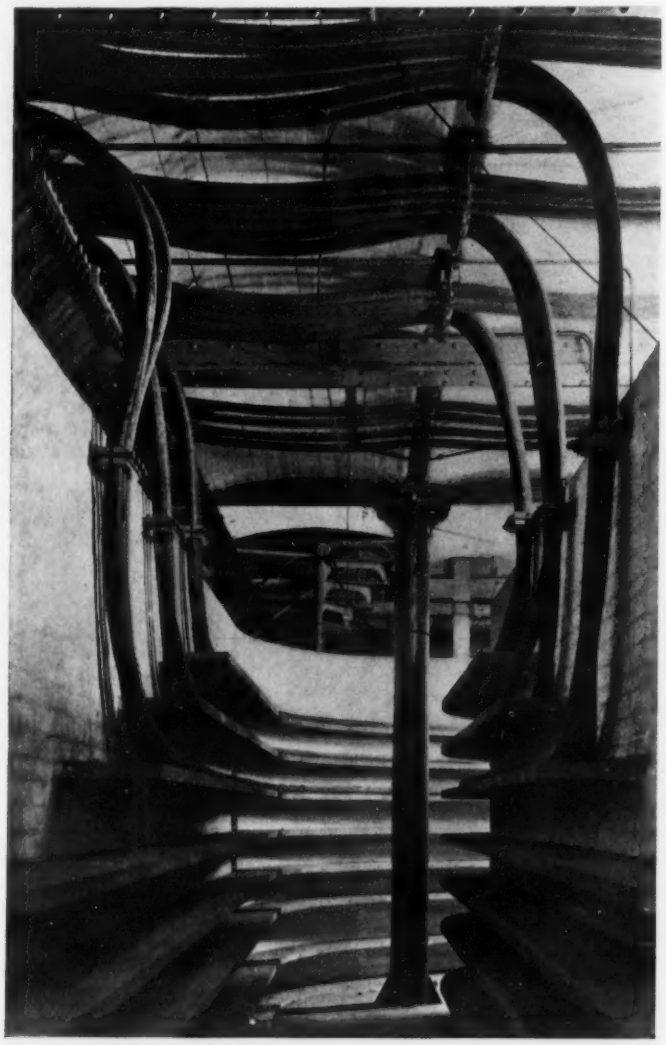


FIG. 2.—CABLE CONDUIT.

Each main generator is provided with multi-pole switches for simultaneously transferring both the positive and the negative from the traction to either of the lighting bars. Two such switches are required on account of the use of three sets of bus-bars, and these are connected in tandem; that is, the up-throw of the first transfer switch connects to the traction bus-bars, while the down-throw connects to the center studs of the other multi-pole switch, which, when thrown up connects to the upper lighting bus-bars, and when thrown down to the lower lighting bus-bars. On this account it is impossible to parallel either pole of the traction with any of the lighting bars. The first of these tandem switches must, of course, be triple-pole in order to close the positive, equalizer and negative to the traction bars; the second is double-pole, the series field coil connection going to a dead stud. In order to avoid closing the armature circuit on the breaker, or closing the armature circuit at the same time as the series field circuit to the traction bars, there is in series with the breaker in the positive lead a further paralleling switch, which is closed after the transfer switches and the breaker are closed. The paralleling voltmeter is bridged around this switch, and its calibration is of a very simple character, as it should always read zero when the switch is closed; the external zero adjustment enables it to be corrected at any time.

FIG. 3.—LAYING MAINS IN EARTHENWARE TROUGHING.

It will be apparent from the above that the many interconnections of the bus-bars involved no little labor in laying out the generator panels. The remainder of the board, with some minor exceptions, was comparatively easy in this respect, as the feeder panels are of one polarity, positive, negative and neutral feeders being kept apart. The heavy trunk main booster panels are similarly arranged with opposite poles on separate panels.

All of the lighting feeders, including the trunk supply to the other stations, are protected by automatic cut-outs. The certainty of operation and the time-limit feature of the fusible cut-out were combined with the circuit-opening capacity of the usual breaker, by a novel construction consisting of a carbon break circuit-breaker held shut by a short copper link fuse which carries the

main current. When this fuse is blown, the arc is shunted by the carbon contacts, which open with the usual speed of a breaker and clear the circuit with a minimum of fusion of the link.

The alternating-current switch gear is considerably more simple than the direct-current gear, while the alternating-current transmission work is unusually free from complications. To each of the seven sub-stations three .25 sq. in. three-core feeders are run; one for lighting, one for traction service and the third as a spare for either lighting or traction; these are supplied from three group bus-bars, one for each service. The generators are connected to one main bus, sectionalized by an oil switch; the lighting feeder bus will be supplied from the lighting end of the generator bus through a non-automatic oil switch, which can be used to clear the whole of the lighting feeder system when required. The traction feeders will be similarly supplied from the traction end of the generator bus-bar. The spare feeders will be equipped with double isolating switches connecting to duplicate bars, one set of which will be supplied from the lighting end of the generator bar, while the other will be supplied from the traction end; this will enable the spares to be independently used on lighting and traction if these two services are kept separate. The two rotary converters are so connected that by properly manipulating the bus section switch and its isolating switches they can be supplied from either the lighting or traction section of the generator bus-bars; corresponding, if desired, with their connections on the direct-current side, which may be to either traction or lighting bars.

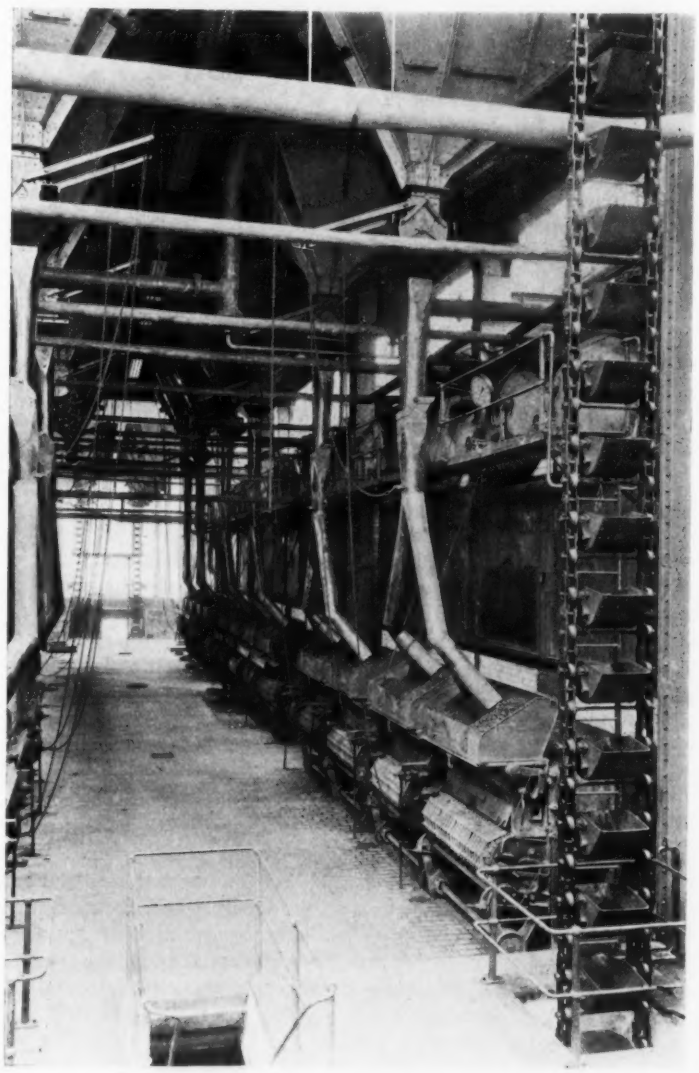


FIG. 4.—BOILER ROOM, CITY OF BIRMINGHAM ELECTRICITY STATION.

The cables connecting the switchboard to the direct-current generators are carried from the basement under the switchboard along subways which are fitted with stone shelves arranged one above the other, as shown in Fig. 2.

There are ten "Land" pattern Babcock & Wilcox water-tube boilers, having an aggregate evaporating capacity of 240,000 lb. of water per hour into steam at 180 lb. pressure and 150° F. superheat. Each boiler is provided with a double mechanical chain grate stoker. The stokers may be driven by either a steam engine or an electric motor.

The boiler house is provided with coal bunkers capable of containing 2,000 tons, and a complete coal conveying system has been installed. The conveyors consist of endless chains to which steel buckets are attached at intervals of two feet. The conveyors carry the coal from hoppers at the ground level to the coal storage bins, and serve to remove the ashes from the boiler pits to ash bunkers. Two 16-hp and one 6-hp motor are employed for driving the conveyors.

The general arrangement and the size of the buildings, as well as the layout of the plant therein contained, have been designed by Mr. R. A. Chattock, the city electrical engineer to the Birmingham Corporation.

Wireless Telephony and Telegraphy.

Four patents were issued to Dr. Lee De Forest on November 13 for wireless apparatus and methods. Two of the patents relate to wireless telephone transmitters while the other two relate to wireless telegraph receivers. The transmitter equipment comprises means for continuously transmitting trains of electromagnetic ether waves having a spark frequency higher than the more essential frequencies accompanying speech waves and means located between the earth connection in the antenna system and the point at which energy is supplied thereto whereby the waves are modified in accordance with speech waves. In Fig. 1 the variable resistance device consists of a megaphone whose diaphragm operates on a reducing valve to vary the flow of air across a spark-gap.

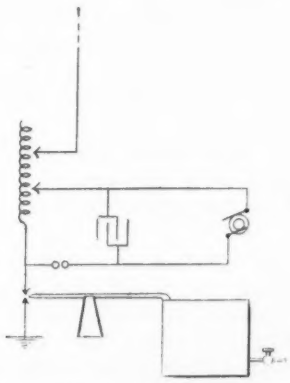


FIG. 1.—WIRELESS TELEPHONE TRANSMITTER.

In the wireless telegraph receiving device shown in Fig. 2, the receiving antenna is associated with a receptacle containing a sensitive gaseous medium, under very small pressure. Within the receptacle are enclosed two electrodes, one of which is an ordinary incandescent lamp carbon filament receiving current from an external battery and the other is a platinum disc. Between these two electrodes and external to the receptacle is a local circuit containing a battery and a telephone receiver. The passage of electrical oscillations across the gap between the electrodes causes a variation in the current through the telephone and produces a sound at the diaphragm.

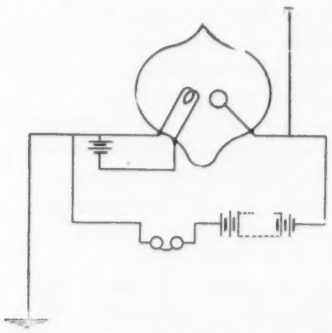


FIG. 2.—WIRELESS TELEGRAPH RECEIVER.

The Single-Phase Induction Motor.—I.

By Alfred Still.

SINCE the following articles dealing with the single-phase induction motor were written, the author's attention has been drawn to certain articles on the same subject which have recently appeared in the Electrical World. In his contributions which appeared on page 326 of the Electrical World of August 18, 1906, Dr. McAllister deals with the principles underlying the action of such motors generally on the lines adopted by the present writer, who desires to express his entire agreement with, and his appreciation of, Dr. McAllister's arguments and methods; at the same time, since there are many minor differences between the two articles referred to, and since Dr. McAllister goes into some details, the understanding of which is not absolutely necessary in order to obtain a correct and practically useful idea of the electromagnetic actions in the single-phase motor, it would seem that those portions of the following articles which deal with the fundamental principles of action may yet be read with advantage even by those who have carefully followed and appreciated Dr. McAllister's admirable treatment of the subject.

Again, in connection with the circle diagram, several very able articles from the pen of Dr. McAllister have already appeared in the Electrical World (see the issues of April 21, May 26 and June 30). These deal very fully with the construction of such diagrams, and prove their correctness within practical limits, and the present writer would, therefore, like to point out that his object in referring to the circle diagrams is not in order to prove their universal application to the alternating-current motor, but merely to show how this exceedingly convenient form of diagram can be derived from the fundamental vector diagrams which he has used for the purpose of illustrating and confirming his reasoning.

The present writer proposes to explain the action of the induction motor without reference to the idea of a resultant revolving magnetic field, and in this he merely follows the lead of H. B. Atkinson, who, fully eight years ago, described all types of alternating-current motors, and studied their behavior and theory without making use of the picture of a revolving field. Although Mr. Atkinson has not until lately been given due credit for the excellent pioneer work that he has done in developing the alternating-current motor, there is hardly a statement made in his paper read before the Institution of Civil Engineers in 1898* which is not absolutely correct. Other workers in this field have either followed his lead or independently arrived at the same conclusions as Mr. Atkinson regarding the best method of studying this class of machinery.

Since the induction motor is practically a transformer with a divided core and a movable secondary, it is useless to attempt any explanation of its action without first considering the elementary theory of the alternating-current transformer.

Principles of the Alternating-Current Transformer.

The ordinary single-phase alternating-current transformer—as used for the purpose of converting a small current at a high potential into a larger current at a lower potential, or vice versa—consists essentially of a closed magnetic circuit made up of thin insulated iron plates upon which are wound two entirely distinct coils of insulated wire, called respectively the primary and the secondary windings, and between which there is no metallic or electrical connection whatever.

The sketch in Fig. 1 represents a section through such a transformer. We shall call the inner coil, *P*, the primary winding, and the outer coil, *S*, the secondary winding. Each of these coils is wound on the central limb of the iron core, which, in the particular design of the transformer, represented in the sketch, is carried round on both sides of the coils, thus forming a closed double magnetic circuit linked with the two electric circuits.

Suppose, in the first instance, that the secondary is open-circuited, while the primary terminals are connected to a source of alternating e.m.f. Under these conditions the existence of the secondary coil may be ignored, and the primary winding, linked with the iron circuit, acts merely as a choking coil, of which the action is as follows. The alternating potential difference at terminals tends to send a current through the coil; and, if it were not for the self-induction—or magnetic flux resulting from the flow of current—the amount of the current would be determined solely by the resistance of the coil; but, owing to the presence of the iron core, and to the fact that the winding encircles it many times, a small value of current will give rise to a comparatively large flux of magnetism, which, in its turn, will generate an e.m.f. of self-induction in the coil. It is necessary, therefore, to consider the presence of two e.m.f's in the same circuit, acting simultaneously, and producing a resultant e.m.f. differing considerably (both in amount and time phase) from the impressed potential difference. It is this resultant e.m.f. which produces the flow of current, the amount of which is limited by the ohmic resistance of the winding. The condition of balance is evidently obtained when the difference between the applied and induced e.m.f's is such that the resulting current will magnetize the iron core to the exact extent required to generate the induced e.m.f. Thus, if the magnetic circuit is a short one, without air-gaps, the ampere turns required to magnetize the iron will be small, and if the resistance of the winding is low, only a few volts will be required to produce the necessary current; the result being that, in a well designed transformer (which fulfills these conditions) the induced e.m.f. is almost equal and opposite to the applied e.m.f. or potential difference at the terminals; and the flow of current, with secondary open circuited, is limited to a very small amount.

It will be readily understood that, since the pulsations of the magnetic flux give rise to an induced or back e.m.f. in the

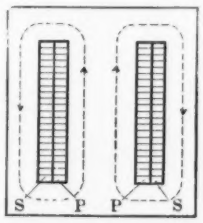


FIG. 1.—SECTION THROUGH A STATIONARY TRANSFORMER.

primary windings, exactly the same thing occurs in the secondary windings, that is to say, the alternating magnetic flux which is linked with both windings, generates exactly the same e.m.f. per turn of wire, in both the primary and the secondary coils. Thus, if there are 1,000 turns of wire in the primary coil, and only 100 turns in the secondary coil, a magnetic flux of such a value as to generate 2 volts per turn of wire at a given frequency, will give rise to a counter e.m.f. of 2,000 volts in the primary winding, and an e.m.f. of 200 volts in the secondary coil.

Imagine now that the secondary winding is closed through a suitable resistance, and note what takes place. The potential difference at the secondary terminals which, so long as the external circuit was open, could produce no current, is now available for doing work, and a current will circulate in the secondary coil, the amount of which will depend directly upon the value of the secondary e.m.f. and inversely upon the resistance and leakage reactance of the secondary circuit and the resistance of the load circuit.

It is evident that even the smallest current in the secondary must have an appreciable demagnetizing effect upon the iron core, and unless the ampere turns produced by this current are immediately counteracted by a current in the primary coil such as to produce an exactly equal magnetizing effect, but in an opposite direction, the balance in the primary circuit would be upset.

The condition of things in a loaded transformer is, therefore, this: The current in the secondary requires the existence of a component of the total primary current which, at every instant flows in such a direction and has such a value as to exactly counteract the demagnetizing effect of the secondary current; but there will be another component of the primary current (generally comparatively small in amount), called the mag-

*"The theory, design and working of alternate-current motors" by Llewelyn Birchall Atkinson, paper read February 22, 1898; see Minutes of Proceedings Inst. C. E., vol. CXXXIII, p. 113.

netizing component, which is required to maintain the flux of magnetism at practically the same value as before the secondary circuit was closed. In other words, the difference between the primary and secondary magnetizing forces is the comparatively small magnetizing force required to create an alternating magnetic flux of the correct amount and phase displacement to maintain the balance of e.m.f's in the primary circuit.

It will be understood how, in a simple piece of apparatus, without moving parts, electrical power can be transferred from one circuit to another by electromagnetic induction, without the necessity of any metallic or elecrical contact between the two circuits. This, the most important property of fluctuating currents, is the chief reason why alternating currents can be used with advantage in many cases, and for many purposes in connection with which continuous currents are not available.

VECTOR DIAGRAM OF THE ALTERNATING-CURRENT TRANSFORMER.

The simple vector diagram for a single-phase transformer has been drawn in Fig. 2. Here OE_2 and OC_2 stand respectively for the secondary e.m.f. and current: The fact that C_2 is drawn exactly in phase with E_2 indicates the absence of reactance in the secondary circuit.

In the primary circuit there will be a back e.m.f. exactly equal to the secondary e.m.f.,* and if we neglect the resistance of the primary winding, this means that the applied potential difference at the primary terminals will be OE_1, drawn exactly equal, but opposite to OE_2. With regard to the magnetizing current, the amount of this will depend upon the nature and arrangement of the magnetic circuit; but, if we neglect the effects of eddy currents and hysteresis in the iron core, the vector of this current must be drawn exactly a quarter period, or 90°, in advance of the induced e.m.f. Let OC_m represent this current; then, in order to produce a resultant magnetizing effect equivalent to that of the current OC_m acting by itself, the primary current must have another component OC_1, exactly equal, but opposite to OC_2, and the total current in the primary circuit will be OC, which is obtained by compounding OC_m and OC_1. The presence of the magnetizing component of the total current is the cause of OC not being in phase with OE_1, and the angle of lag, θ, is a measure of the phase difference between current and pressure in the primary circuit.

Although the magnetizing component (OC_m) of the primary current has been drawn in Fig. 2 on the assumption of there

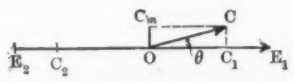


FIG. 2.—SIMPLE VECTOR DIAGRAM OF TRANSFORMER.

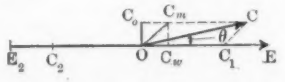


FIG. 3.—VECTOR DIAGRAM TAKING IRON LOSSES INTO ACCOUNT.

being no iron in the magnetic circuit, or of negligible losses in the iron core, it should, perhaps, be pointed out that the diagram does not become unduly complicated if these losses are taken into account.

The effect, both of hysteresis and of the eddy currents in the iron core is to cause waste of power, which is dissipated in the form of heat. The power lost by hysteresis and eddy currents must necessarily be supplied in the form of additional watts taken from the primary source of supply, and the effect on the vector diagram will be exactly the same as if a slightly larger current than C_2 (Fig. 2) were taken from the secondary coil. Thus, if the total watts lost through hysteresis and eddy currents amount to 200, and if the primary supply pressure is 2,000 volts, there will be a component of the total primary current in phase with the pressure, amounting to $\frac{200}{2000} = .1$ amps.; and, in Fig. 3 where the iron losses have been taken into account, the magnetizing current will no longer be at right angles to OE_2, but will consist of the wattless component OC_o (equal to OC_m in Fig. 2), and the power component, OC_w, in phase with OE (this being drawn to such a scale as to represent .1 amps. if the numerical example is to be satisfied). By combining OC_o and OC_w, we obtain OC_m, which is the true magnetizing current; and OC — the resultant of OC_m and OC_1 — is the total primary current.

Although no difficulty need be experienced in taking account of the various losses which occur in a transformer, not only in the iron core, but also in the copper windings, it would be a mistake to complicate the diagrams, even to a small extent, by introducing a number of comparatively trifling corrections, when the chief purpose of these articles is to explain the broad principles governing the action of the induction motor; and it should be noted that Fig. 2 accurately represents the condition of things in a loaded transformer, the only assumptions being:

(1) That the whole of the magnetic flux which passes through the primary windings threads its way also through all the turns of the secondary winding, i .e., there is no magnetic leakage.

(2) That the power lost in the iron core is negligible.

(3) That the resistance of the primary winding is negligible.

We are now in a position to study the forces at work in a single-phase induction motor.

ESSENTIAL FEATURES OF THE SINGLE-PHASE INDUCTION MOTOR.

In an induction motor, the magnetic circuit may be considered as made up of two parts, the stationary portion, or *stator*, and the revolving portion, or *rotor*. It does not matter whether the exciting or primary conductors are wound on the stator or rotor portions of the magnetic circuit; but it is customary to wind the stator with the primary or inducing windings, and one advantage of this arrangement is the absence of any slip rings or rubbing contacts which would otherwise be necessary for

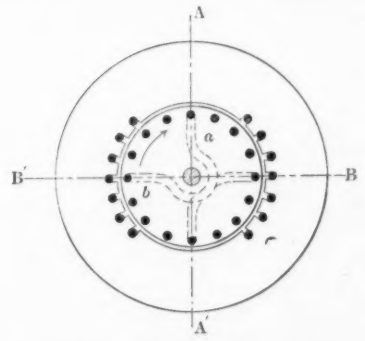


FIG. 4.—ARRANGEMENT OF COILS OF SINGLE-PHASE MOTOR.

conveying the current from the source of supply to the primary coils. We shall, therefore, suppose the ring portion, or stator, in Fig. 4, to carry the primary windings, while the rotor or revolving armature carries the secondary conductors. The motor shown diagrammatically in Fig. 4 is a two-pole one, and it will be seen that the disposition of the primary windings in slots on the inner periphery of the laminated iron ring produces a magnetic field through the rotor, of which the resultant is in the direction of the vertical diameter, AA'. The air-gap between the two portions of the magnetic circuit is merely a mechanical clearance, and is made as small as possible, for reasons which will be understood later. With regard to the rotor, this has no commutator, but the conductors are threaded through holes very near to the periphery of the iron stampings, and short-circuited upon themselves; that is to say, whether the rotor is of the *wound*, or *squirrel-cage* type, the result electrically is the same as if pairs of conductors, cutting through magnetic fields of opposite polarity, were joined across the ends of the armature by means of substantial copper connectors. Thus, in the case of a two-pole machine, each conductor may be considered as being joined to the conductor diametrically opposed to it, by connections across the ends of the rotor, generally as indicated in Fig. 4 for two of these rotor circuits only.

Now consider what takes place when the primary circuit is closed, the armature, or rotor, being at rest. The flux of alternating magnetism through the rotor in the direction, AA', causes a heavy flow of current in all short-circuited rotor coils lying in a horizontal direction, such as b; but as the only effect of these currents is to produce a magnetizing force also in the direction of the diameter, AA', there is no tendency for the armatures to re-

*The ratio of transformation for this, and subsequent diagrams is assumed to be $\frac{1}{1}$; that is to say, the necessary corrections are supposed to have been made so as to reduce the effective primary and secondary turns to the same amount for the purpose of comparison.

volve, and it follows that the single-phase motor, unless fitted with auxiliary devices, is *not self-starting*. But let us suppose the armature to have been given a start, and observe what other forces are now at work. The conductors situated on or near the vertical diameter, *AA'*, are now *cutting through* the magnetic flux due to the primary coils, with the result that an alternating e.m.f. of rotation is generated in them. This e.m.f. produces a flow of current in the short-circuited coils which, in its turn, gives rise to a cross magnetic flux in the horizontal direction, *BB'*, exactly at right angles to *AA'*. The currents in the horizontal coils, *b*, are now able to react upon this cross magnetism (which had no existence while the rotor was at rest) and it can be easily shown that the direction of the resulting torque is such as to maintain the rotation of the armature, which will continue to revolve in the direction imparted to it by the initial starting impulse.

As the speed increases, the rate of cutting through the field, *A*, increases, thus raising the e.m.f. in the coils, *a*, and consequently the cross field, *B;* the limit being reached when this latter field is practically of the same value as the main field, *A*. The speed will then be practically *synchronous,* or equal to the frequency of supply, and—even if friction and other losses could be considered negligible—the speed cannot exceed the speed of synchronism, because this would involve the idea of the back e.m.f. in the coils, *b*, due to rotation in the cross field, *B*, being greater than the induced e.m.f. in the same coils due to the alternations of the main field, *A*, which is obviously absurd.

In fact the alternating-current induction motor has its parallel in the shunt-wound continuous-current machine, which reaches its maximum speed when the back e.m.f. of rotation is practically equal to the applied potential difference across the brushes; the chief difference being that, in the alternating-current machine, no brushes are used, the pressure being impressed on the rotor windings by electromagnetic induction through the air-gap.

Although we have, for the sake of simplicity, considered—and shall continue to consider—the action of the two-pole machine, nearly all induction motors are multipolar. This merely necessitates such an arrangement of the stator windings as to produce alternate poles of the same sign round the inner periphery of the stator; and the actual speed of rotation, when running light, will depend only upon the number of pairs of poles and the frequency of the supply; variations in the supply pressure do not appreciably affect the speed.

We shall now pass from this somewhat superficial account of the forces at work in the induction motor, to a more detailed examination of the principles involved in the transfer of power from the stationary primary winding to the revolving rotor with its short-circuited secondary conductors.

THEORY OF THE SINGLE-PHASE INDUCTION MOTOR.

It is not at present proposed to consider the starting conditions of single-phase induction motors, and, therefore, it will be assumed that the rotor is revolving either at its maximum possible speed (i. e., the speed of synchronism), or at a speed not much below that of synchronism.

Referring to Fig. 4, it should be noted that, so far as the magnetic field of the rotor windings is concerned, this may be resolved into two magnetic fields at right angles to each other. Thus, all currents directly due to the alternating inducing field can produce a magnetizing force only in the same direction as the inducing field; i. e., along the axis, *AA'*, while any currents due to the e.m.f's generated in the armature conductors by rotation in the inducing field, can give rise to a magnetizing force only in the direction, *BB'*, exactly at right angles to the axis, *AA'*.

It is, therefore, possible, for the purpose of studying the action of the motor when running, to imagine the actual rotating conductors replaced by two coils at right angles to each other and stationary in space. This treatment greatly facilitates the understanding of the subject and gets over certain difficulties arising from the notion of varying frequencies in the rotor conductors, depending upon the speed of rotation. There is only one frequency to consider, and that is the frequency of the supply, which, instead of following, in thought, the actual rotor conductors as they are carried round through the magnetic field it is necessary merely to study the effect upon the primary circuit of a system of stationary secondary conductors which is exactly equivalent (magnetically) to the actual distributed rotor winding revolving at any given speed.

Referring to Fig. 5, the primary or inducing winding is shown for simplicity in the form of a single coil, *P. P.*, entirely surrounding the rotating armature. In practice this winding is distributed, i. e., it consists of wires passing through a number of slots, as indicated in Fig. 4; but the essential feature of this winding is that it produces an alternating magnetic field, N_a, through the rotor, in the direction of the vertical diameter, *AA'*. With regard to the rotor—which is supposed to be revolving in the direction indicated by the arrow—the actual conductors have been replaced in Fig. 5 by two imaginary stationary coils, *a* and *b*, at right angles to each other, the first of which can exert a magnetizing force only in a horizontal direction along the diameter, *BB'*, while the magnetizing force of the coil, *b*, will coincide in direction with that of the primary exciting coil. We shall now consider, step by step, how the transfer of power takes place between the primary and secondary circuits.

In the first place, the supply pressure connected across the terminals of the stator winding, *P.P.*, produces a magnetic flux, N_a, in the direction, *AA'*, of such a value as to induce the required back e.m.f. in the primary winding, exactly as in the case of a choking coil, or the primary circuit of an ordinary stationary transformer. In addition to this, the flux, N_a, produces (1) an induced e.m.f. in the coil, *b*—which may be looked upon merely as the secondary winding of an ordinary transformer—and (2)

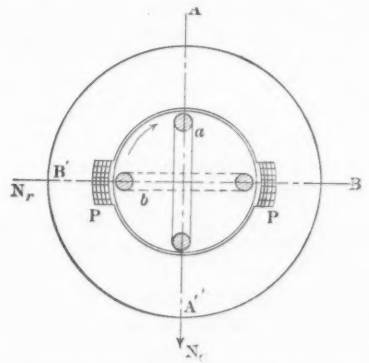


FIG. 5.—EQUIVALENT STATIONARY COILS OF SINGLE-PHASE MOTOR.

an e.m.f. of rotation in the coil, *a*, depending upon the speed of the motor; i. e., on the rate at which the rotor conductors are cutting through the alternating field, N_a. It is clear that if there were no other e.m.f's to be considered, very heavy currents would flow in the short-circuited coils, *a* and *b*; but note that the coil, *a*, is practically embedded in iron, and instead of the rotational e.m.f. generated in it, causing an immediate and large flow of current in phase with this e.m.f., the only current that passes is a small magnetizing current which—by creating a magnetic flux, N_r, along *BB'*—will induce a back e.m.f. in the coil, *a*, very nearly equal and opposite to the e.m.f. generated by rotation.

Thus it is that a cross magnetizing field is created when the armature is in motion; and since the horizontally placed rotor conductors (represented in Fig. 5 by the coil, *b*), must necessarily cut through the cross flux, N_r, there will be produced in the coil, *b*, an e.m.f. of rotation in addition to the induced e.m.f. already referred to; and it remains only to be shown how this rotational e.m.f. is opposite in phase to the e.m.f. induced by the alternating main flux, N_a; for this will explain how, by the lowering of the resultant e.m.f., the current in the coil, *b*, is limited to the required value.

Consider the phases of the e.m.f's in the coil, *b*, relatively to the phase of the main flux, N_a. The pulsations of this alternating flux will induce a secondary e.m.f. in the coil, *b*, which we shall denote by the symbol, E_{sp}; it will lag 90 time degrees behind the inducing flux, N_a. The rotational e.m.f. generated in coil, *a*, as the conductors cut through the inducing field will be in phase with—or opposite in phase to—the main flux, N_a, and it will give rise to a cross flux, N_r, which, if we

assume the resistance of the coil, *a*, to be negligible, must lag 90 time degrees behind this rotational e.m.f. (because only thus can it induce a back e.m.f. in *a* opposite in phase to the rotational e.m.f.) It is therefore clear that, since the cross flux, N_r, and the induced e.m.f., E_{zp}, in *b* are both 90 time degrees out of phase with the main flux, N_a, the rotational e.m.f. E_{zr}, in the coil, *b*, due to the rotation of the conductors through the field, N_r, will be practically in phase with—or rather opposite in phase to—the induced e.m.f., E_{zp}.

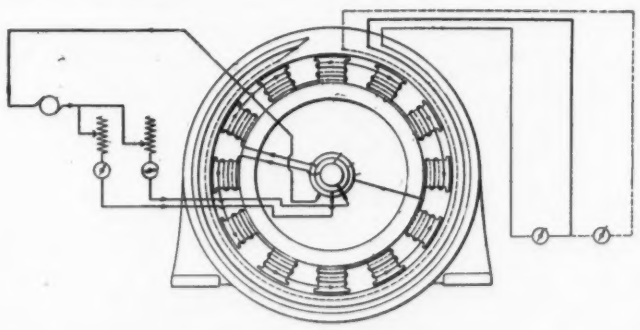
The magnitude of the rotational e.m.f., E_{zr}, will depend upon the speed of rotation and the strength of the cross field. At synchronous speed, when the rate at which the conductors (*a*) cut through the main flux, N_a, is the same as the rate at which this flux *pulsates through* the coil, *b*, the mean value of the rotational e.m.f. in *a* will be the same as the mean value of the induced e.m.f. in *b*, and the cross flux, N_r, will, therefore, be equal to the main flux, N_a. This cross flux will, in its turn, give rise to a rotational e.m.f., E_{zr} in *b*, of which the mean value is also exactly the same as the mean value of the pulsational flux, E_{zp}, in the same coil (*b*); and since these two e.m.f's will be in opposition, there will be no flow of current in *b*, and the motor will be running without loss.

In practice the speed of synchronism is never quite reached (it cannot be *exceeded* because this would imply the return of energy to the primary circuit). As the load comes on, there is a slight reduction in speed—the amount of which, for a given torque, will depend upon the resistance of the rotor circuits—this instantly causes a lowering of the rotational e.m.f. in the coil, *a*, with a consequent reduction in the amount of the cross flux, N_r. Now, so soon as the value of the cross flux falls below that of the main flux, the rotational e.m.f. in *b* falls below the value of the induced e.m.f., with the result that a current *in phase with the induced e.m.f.*, E_{zp} (and, therefore, in phase with the cross flux, N_r), will flow in the coil, *b*. It is this current which, by reacting upon the cross field, exerts the required torque to keep the motor running under load; and it is also this current which, by its tendency to disturb the magnetic condition in the primary circuit, permits the flow of a primary current, opposite in phase to the secondary current and, therefore, in phase with the applied potential difference across the primary terminals.*

Although references to the idea of a rotating magnetic field have been purposely avoided, it may, perhaps, be useful to note that, if a single-phase induction motor were running at exactly synchronous speed, the equality between the main and cross fields produces exactly the same effect as a resultant flux of constant value rotating with the speed of synchronism**, i. e., at the same speed as the rotor, and in the same direction.

Testing Large Alternators.

Mr. B. A. Behrend, on November 20, obtained a patent for the method of testing alternating-current machines by dividing the



TESTING LARGE INSULATORS.

field windings into sections arranged to act as motor and generator, respectively, with which method his name has frequently been associated. The connections for the test are shown in the accompanying illustration. Different values are used for the exciting currents for the motor section and the generator section of the field winding, so that the resultant magnetic field produced by the interaction of the impressed and induced fields are the same for each pair of poles, and the machine is in perfect magnetic balance. The machine is operated under full load conditions without waste of power other than the amount necessary to overcome the losses.

*The effects of magnetic leakage are, for the present, neglected.

** A sine wave form of e.m.f., and if simple harmonic space distribution of the magnetic flux in the air-gap must be assumed, if this statement is to be scientifically accurate.

Electrical Ignition in Internal Combustion Engines.—II.

By F. W. SPRINGER.

THE JUMP-SPARK.

IN THE jump-spark system of ignition use is made most frequently of the vibrating induction coil. In operation the circuit is completed on the engine by a contact maker, preferably of the striking roller type, called a timer, during a definite per cent of one revolution. The length of the time of the contact depends upon the arc of contact in the timer and upon the speed of the engine.

The rate of increase of the current in the primary coil on closing the circuit is essentially the same as in the case of a touch-spark coil. Several current growth curves, *A, B, C, D, E*, Fig. 9, have been plotted to show the rate at which the current increases while using batteries having different resistances and voltages with the coil shown in Figs. 10 and 11. The accompanying table shows the data upon which the curves of Fig. 9 have been based. It is

TABLE FOR FIG. 9.

Curve.	Volts. E	Ohms. R	Coef. of Ind. L	Sec. $T=\frac{L}{R}$	Amp. I at $t=.008$	Joules stored. J	Amp. Max. I_m	Stored Joules Max. J_m
A	5.6	0.9	0.0044	0.0049	5.1	0.058	6.23	0.085
B	11.2	1.8	0.0044	0.0024	5.8	0.074	6.23	0.085
C	5.6	0.45	0.0044	0.0098	7.0	0.108	12.5	0.344
D	11.2	0.9	0.0044	0.0049	10.2	0.228	12.5	0.344
E	11.2	0.45	0.0044	0.0098	13.7	0.414	25.0	1.375

evident from the curves and table that the current increases most rapidly when the total resistance is a minimum and the

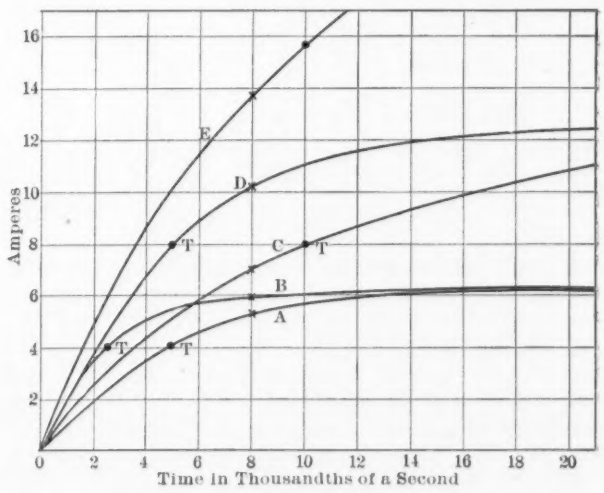


FIG. 9.—AMPERE-TIME CURVES.

battery voltage a maximum. Curve *A*, Fig. 9, represents the conditions under which the coil is generally used.

As the current increases there is exerted upon the hammer, *H* (Figs. 10 and 11), a magnetic pull, which increases nearly with the square of the current; for a given current the pull increases, also, nearly as the inverse square of the distance between the hammer and the end of the core *M*.

The current eventually reaches an amount such that the pull is sufficient to overcome the force of the spring, *G*, and it draws the hammer down with a velocity which is increased by the rapidly increasing accelerating force.

The force tending to increase the velocity of the hammer is numerically equal to the difference between the total magnetic pull at any time and that force necessary to overcome the tension of the spring, *G*, combined with the slight gravitational force.

Referring to curve *A*, Fig. 9, it was found that by very slowly increasing the current 1.75 amp. were required to start the hammer, *H*, from the stop, *T*, of Fig. 10; the maximum accelerating force would then be proportional to the difference between the square of this current and a maximum of the square of approximately 5 amperes at the break. If this spring tension and distance were such that it required, for example, 4 amperes to move *H*, it is evident that the hammer would acquire a very small velocity before striking the contact spring, *D*. Curve *E*, Fig. 9, would give a much greater accelerating force, the larger current acting for a shorter time and hence giving the hammer a proportionately greater velocity. The contact at *N* is thus broken by a hammer blow, whose energy varies as the square of the velocity of the hammer and directly as its weight.

The speed with which the contact is broken depends upon the relative inertias of the hammer, *H*, and of the vibrator, *D*, upon the stiffness of the spring, *D*, upon the velocity of *H*, and upon the relation of the direction of motion to the plane of the contact at *H*. The hammer, *H*, is returned to the original position largely by the spring, *D*, and is held in place by *G*.

Evidently the following conditions will result in a quick break: 1, weak spring, *G*; 2, rapidly increasing primary current such as curve *E*, Fig. 9; 3, a considerable distance between *H* and *D*, Fig. 10; 4, a vibrator, *H*, whose weight has been increased to the maximum amount to which it can be increased and have the magnetic pull increase in the same ratio as the weight; 5, ending of the effective blow of *H* close to the core, *M*; 6 a weak and light spring, *D*; 7, large, perfectly flat contacts at *N*, Fig. 10, with the plane of contact perpendicular to the motion of *D*.

In any case, a quick break can be obtained only when the hammer, *H*, strikes *D* with a great velocity.

The following factors and conditions affect the rate of vibration:

1. The natural vibration period of the hammer, *H*, as determined by its weight, length and the adjustment of the spring, *G*, and spring, *D*. 2. The rate of current increase as determined by the resistance, self-induction and voltage in the primary circuit, and the reverse current in the secondary coil as determined by conditions in the external secondary circuit. 3. The length of time of contact at *N* as determined by the relative positions of the movement ranges of *H* and *D*, and the position of the core stop, *M*. 4. The relative weight and stiffness of the spring, *D*. 5. The length of the range of motion of the moving parts. 6. The rebounding surfaces of the stops, as *T*. 7. Amount of arcing at *N*. 8. Eddy currents and hysteresis in the core. 9. The coincidence of the different forces in time and direction.

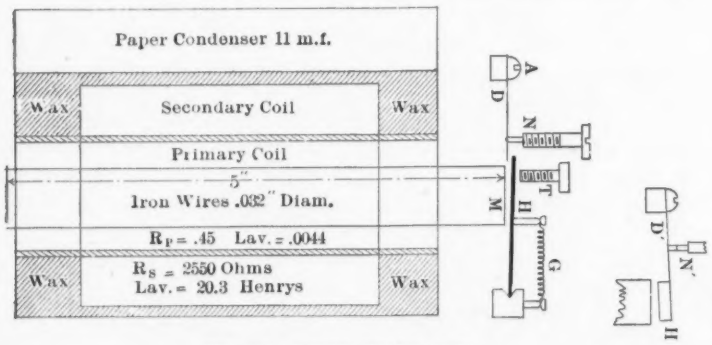


FIG. 10.—JUMP SPARK COIL.

A reverse current in the secondary coil opposes the magnetizing effect of the primary coil and also reduces the effective self-induction, resulting in a quicker building up of the primary current and a less effective magnetizing force on the core, *M*, and hammer, *H*.

A reverse current occurs with a short-circuited secondary, as shown in Fig. 15, or when there is capacity introduced into the secondary circuit, as, for example, a parallel condenser such as that shown in dotted lines at C_s in Fig. 11.

Fig. 12 shows the natural decay current curve when the secondary of the coil shown in Fig. 10 is short-circuited. This curve would, however, be greatly modified in practice by conditions in the primary coil circuit (see Fig. 15).

When the hammer, *H*, breaks the contact at *N*, the condenser, *C*, Fig. 11, accepts the flow of current in the primary circuit without introducing any appreciable reactance in the circuit or increasing the difference of potential around the points at *N*, Figs. 10 and 11. This condition prevails, however, only when the time required to completely separate the points at *N* is small as compared with that of the charging curve of a condenser as shown in Fig. 13, which is a matter of millionths of a second.

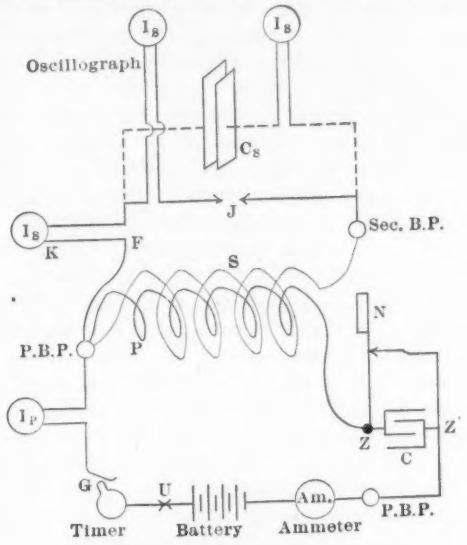


FIG. 11.—CIRCUITS OF COIL.

It may be assumed, for example, that the current in the primary coil is a very large one, say 25 amperes, the condenser resistance .01 ohm, and that the contact at *N* is broken instantaneously, shifting the flow of current from *Z'NZ* to *Z'CZ*; Fig. 11, then, since $t = O$,

$$I = \frac{E}{R} \times \frac{1}{2.718^{\frac{t}{R}}} \text{ becomes}$$

$$\text{by substitution } 25 = \frac{E}{.01}, \text{ whence } E = .25 \text{ volts, which is too small}$$

a voltage to maintain an arc at *N*.

Since the condenser becomes charged in a time so short that it would appear as a vertical line on the time scale used in Figs. 9 and 12, it is evident that the primary current is almost instantaneously stopped, and hence the rate of change of the lines of force about the primary and secondary coils is exceedingly great, and far greater than that occurring during the building up of the primary current.

The maximum value to which the current builds up in the primary coil with a given vibrator adjustment varies greatly with the different curves, curve *E*, Fig. 9, giving the largest value. This is due to the fact that the time required to pull *H* down depends not only upon the accelerating force but also upon the time during which it acts, so that the current which rises most rapidly will reach a larger value and act for a shorter time, i. e., the velocity of *H* will be greatest.

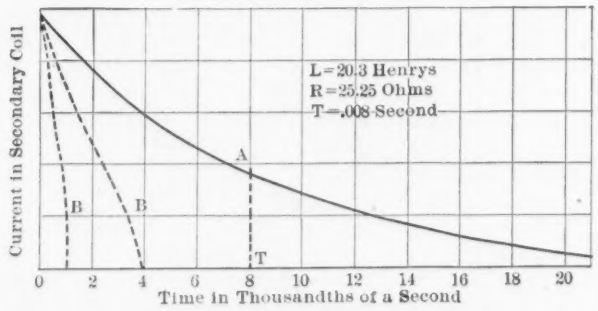


FIG. 12.—DECAY CURRENT-TIME CURVES.

Since the magnetic energy, *J*, varies as the square of the current, a slight change in the vibrator adjustment or in the battery used will make a great difference in the amount of magnetic energy and the size of the spark at the time of the break.

Curves *A* and *D*, Fig. 14, show the great difference in the magnetic energy for the same time of contact at *N* when using the apparatus of curves *A* and *D* of Fig. 9. In order to hold the contact for the same time in the two curves noted above, it would, of course, be necessary to increase the distance between *H* and *M*, or to increase the spring tension of *G* in the case of curve *D*.

The following experiments were undertaken in order to dis-

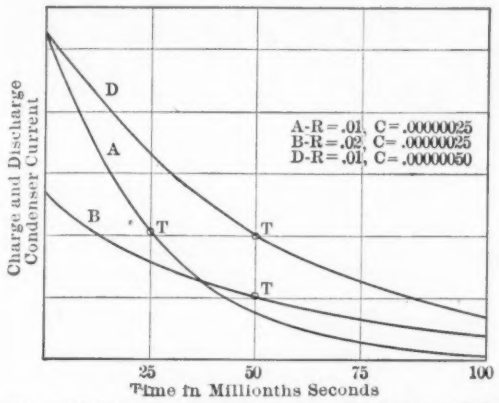


FIG. 13.—CONDENSER CURRENT UNDER CONSTANT PRESSURE.

cover the variations of the different factors having to do with the operation of a vibrating jump-spark coil.

The experiments were all made on the coil shown in Fig. 10. A spark gap with conical points was connected, as shown in Fig. 11, ¼ in. being adopted as equal in disruptive arc distance to that of an ordinary spark plug gap in an engine cylinder during compression.

By means of a needle pointed spark-gap and micrometer screw it was found that the e.m.f. of the secondary coil was equal to 11,800 volts when using three storage cells as the source of energy.

The first experiments on the coil were made by the falling-plate method to determine the number of vibrations per minute and the igniter lag under different conditions. This method consisted simply in setting the coil and a tuning fork (129 v) so that a stylus placed upon the coil hammer and tuning fork, respectively, traced wavy lines upon a smoked glass plate. The primary contact was completed by a wiping contact during the fall of the board upon which the smoked glass plate was mounted. Also a paper strip was mounted on the same board and so arranged that the secondary current could spark through it, leaving a record of each spark.

This method is very satisfactory for the purposes mentioned, but there are so many other conditions connected with the operation of a spark coil that it has been discarded in favor of a Duddell double high frequency type oscillograph.

The oscillograph, which was connected as shown diagrammatically in Fig. 11, was arranged to record the primary and secondary currents, as indicated in the figure at I_p and I_s. The records were taken on a photographic plate while being moved at the rate of about one inch per .014 second. The contact, which

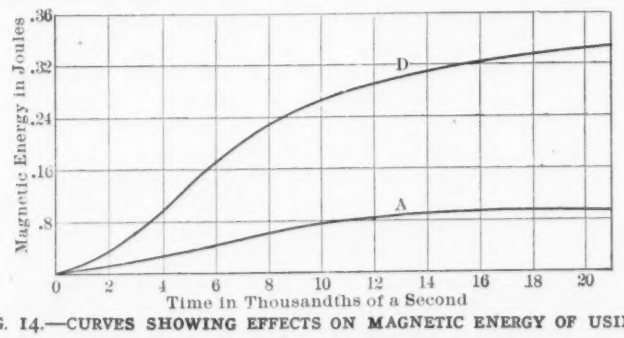


FIG. 14.—CURVES SHOWING EFFECTS ON MAGNETIC ENERGY OF USING DIFFERENT VOLTAGES.

was made during the passage of the plate holder, as at *G*, by a flying contact maker, corresponded to the time of contact during 25 per cent of one engine revolution with an engine speed of 320 r.p.m.

The vibrator was adjusted so that 1.75 amperes gradually applied would just start the hammer, *H*, from the stop, *T*, Fig. 10.

The records shown in Figs. 15 to 20, inclusive, have been selected as the most typical of those taken, and the data and a few calculations are arranged in the following table:

DATA TABLE FOR FIGS. 15 TO 19.

Figures	18	15	17	19	16
Voltage of storage bat.	6.6	4.3	6.5	6.5	6.5
Vibrations per second	115	112	108	107	98
Igniter lag in seconds	.0065	.0017	.0099	cont.	cont.
Average prim. current I_p	1.61	2.65	1.7	1.57	1.65
Coulombs per vib. (Q)	.014	.024	.016	.015	.017
Q x No. of cells (J chem.)	.042	.072	.032	.045	.052
Average watts (W bat.)	10.6	17.5	7.3	10.35	10.9
Energy per vibra. (J bat.)	.092	.156	.068	.097	.111
Max. prim. current. I_p max	4.7	4.7	3.4	4.16	4.16
Core energy J prim. $L/2\ i^2$	.049	.049	.025	.038	.038
Time of prim. contact	.0051	.0067	.0079	.0062	.007
Time of prim. open circuit	.0036	.003	.002	.0031	.003
Duration of second cur. Approx.	.0014	cont.	.001	.002	0
Max. secondary current	.038	.045	.026	.023	0
Core energy J second. $L_s/2\ I_s^2$	.015		.007	.0055	0
Condenser, secondary	wires	0	wires	C	0
Spark gap	.25″	shorted	25″	25″	open
Character of spark	good	none	very little	good	none
Vibrator sparks at N	no	no	no	no	no

The following may be noted on comparing the different records:

The curves in Figs. 16 and 17 are substantially the same as the logarithmic curves in Fig. 9 and the unbuilding curves at *B*, Fig. 12.

The reverse secondary current in Fig. 15 is practically equal in quantity to the direct discharge. (This is of interest in electrolytic resistance measurements.) The primary building up curves in Fig. 15 are nearly vertical owing to the reduction of effective primary self inductive e.m.f. The tops of the I_s curves at M, etc., correspond to the decay curve *A* in Fig. 12.

The chattering of the vibrator is clearly shown on the zero line in the I_p curves of Fig. 18.

The number of vibrations increases with increase of the battery voltage.

The igniter lag, i. e., the time elapsing between the primary

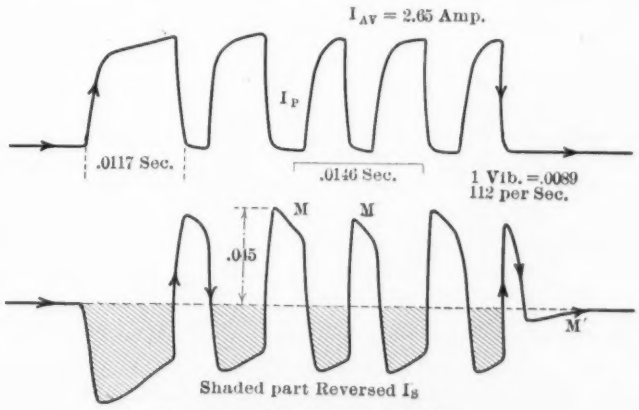


FIG. 15.—OSCILLOGRAPH RECORD.

contact and the first spark, decreases with increase of the voltage.

The time of vibrator contact decreases with increase of the voltage.

On comparing curves *I*, Figs. 16 and 18, there appears to be very little difference in the amount of energy taken from the battery, although one delivers a spark and the other does not.

The average current taken by the primary coil decreased with increase in battery voltage, except when the secondary gap was short-circuited, when it increased.

The maximum voltage of the secondary coil is reduced by the use of condenser, as C_s, Fig. 11.

The introduction of a non-inductive resistance in the primary circuit resulted in a decrease in the number of vibrations, a decrease in the secondary voltage and size of the spark, and an increase in the average primary current taken from the battery. The spark-gap was .25 in. and the battery voltage 6.6. The presence of the condenser, C_s, Fig. 11, produced a marked effect on the spark. It was found that two pieces of tin-foil, of a few square inches area, placed on the opposite sides of a plate of common window glass and connected as shown in the figure changed the character of the spark entirely. It became fatter, whiter and then, with a slight increase in the area of tin-foil, stopped altogether. When the condenser capacity was adjusted to give the largest spark, i. e., adjusted for resonance, sometimes the spark would not start immediately when the circuit was

opened at *U*, Fig. 11, and then closed. The curve, I_s, Fig. 19, shows the secondary to be variable when the capacity is nearly correct for producing resonance, the secondary current being on the increase when the record was taken. It would appear from this that the condenser should have a capacity considerably less than that producing resonance if used to intensify an ignition spark, otherwise the igniter lag would be prohibitive.

The parallel condensers, C_s, were of the order of .0001 microfarad, which is so small that the secondary capacity of the gap itself also exerted a marked effect on the spark; as a result it was necessary to reduce all secondary connections to the simplest condition possible in order not to mask the results to be obtained by varying C_s.

The line, *FK*, Fig. 11, consisted of 12 ft. of No. 12 rubber covered lamp cord and on opening the switch at *K* it was found that the capacity of the wire enabled a very good spark to be obtained at *J* with the secondary circuit open at *K*. We may conclude, then, that all secondary condenser adjustments should be made with a particular battery, coil, coil adjustment and engine wiring in actual service.

It is interesting to note that the capacity of C_s as calculated from well known equations is $.0_{10}707$ farads.

On substituting the value of the induction of the coil in the equation expressing the condition of resonance

$$2\pi f L = \frac{1}{2\pi f C}.$$

$$f = \sqrt{\frac{1}{\frac{}{2\pi}^{.2}} \times 20.3 \times .0_{10}707}.$$

$\frac{1}{f}$ = .00024 sec., the time of one complete cycle at the rate shown at $Z'K$ (Fig. 18).

The conditions in the spark-gap, *J*, Fig.11, depend upon the engine compression, the length of the gap, and the form of the terminals.

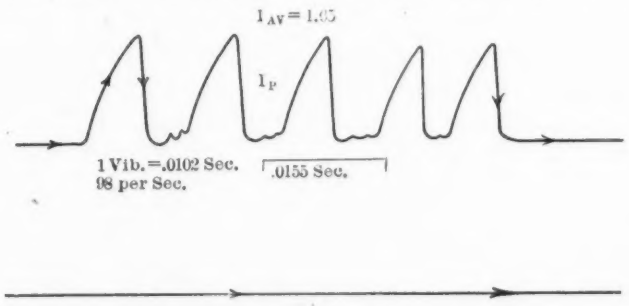


FIG. 16.—OSCILLOGRAPH RECORD.

The discharge rate of the energy of the secondary coil as determined by the above factors and conditions of the coil will next be considered with reference to Fig. 18.

(1) The primary circuit is closed at *P*.

(2) The current then rises on the curve, *PM*, the increasing magnetic flux inducing an e.m.f. in the secondary coil, *E*, which is a maximum at the start of the curve, as at *P*, and equal to:

$$E_s = V_B \times \frac{N_s}{N_p} = V_B \sqrt{\frac{20.3}{.0044}} = 68\,V_B = 448 \text{ volts},$$

where N_s and N_p are respectively the number of turns of wire on the primary and secondary coils, .0044 and 20.3 henries the self-induction of the coils, and V_b is the battery voltage.

(3) The pressure, 448 volts, in the secondary coil causes a slight surge of current in the coil and a displacement current in the spark-gap and any condenser that may be connected in parallel.

(4) As the primary current rises, the rate of change in the magnetic flux grows less and the secondary current surges back again, the total result on reaching point *M* in the primary curve being a loss of energy in the secondary coil and a curve, *PM*, rising more rapidly near *P* and a flatter curve near *M*. (See Fig. 15.)

(5) At some point beyond *M* the vibrator opens the primary circuit at *N*, Fig. 11, and the current begins to fall at a rate depending upon the arc at *N*, the eddy currents and the hysteresis in the core, the capacity of the condenser and the resistance in the condenser circuit. In any case, at some point, as *Z*, the rate of change in primary current, and consequently, also in the magnetic flux $\frac{d\phi}{dt}$ reaches a value such that the e.m.f. induced in the secondary coil charges the points, *J*, Fig. 11, sufficiently

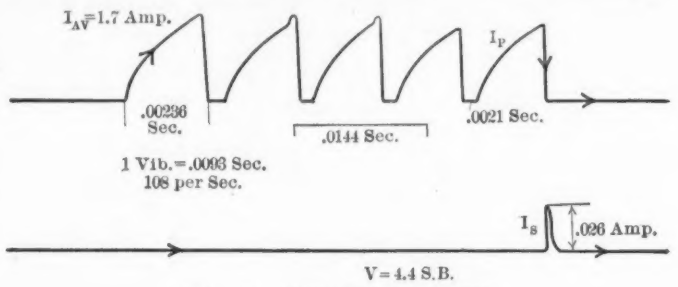


FIG. 17.—OSCILLOGRAPH RECORD.

to break down the spark gap and starts the secondary discharge current as at *Z'*, Fig. 18.

At this point there are several almost simultaneous conditions to be borne in mind:

(6) Between *M* and *Z* the primary condenser, *C*, is charged by the inductive pressure which results after the break at *N*, Fig. 11, and equals

$$E_p = \frac{E_s}{68} + 6.69 = 120 \text{ volts}.$$

This results, of course, in a surge of primary current in the coil and condenser, *C*, in the same direction as that of the battery current.

(7) At the same time there is a surge of secondary current which charges the spark points at *J*, Fig. 11, to the breaking down pressure, probably between 6,000 and 8,000 volts in the present case.

(8) As a result of a leakage current at the spark points the positive spark point is fused, and small particles of vapor are carried in a thin stream by electrostatic attraction to the opposite point.

(9) The instant that the gap is bridged by this vapor, conduction is established and the static energy is instantly released, which, together with the regular flow of current caused by the continued induction as the primary current continues to fall on the curve *ZN*, Fig. 18, greatly increases the expenditure of energy in the gap.

(10) The instant the secondary current begins to discharge, as at *Z'*, the secondary ampere-turns reduce the rate of change of the magnetic flux noted between *M* and *Z*, and the primary charge noted in (6) surges back, counteracting to some extent the ampere-turns of the secondary discharge between *Z'* and *K* and tending to increase the secondary discharge rate.

(11) The secondary discharge increases almost instantaneously to a maximum on *Z'K* equal to .038 amperes, the net inductive

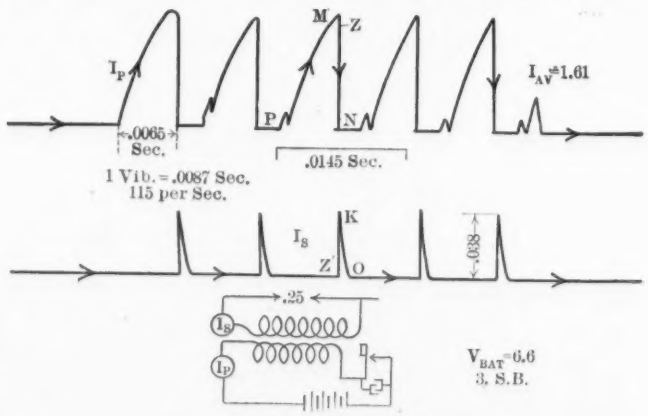


FIG. 18.—OSCILLOGRAPH RECORD.

effects of the changing currents in the primary and secondary coils producing an e.m.f. just sufficient to balance the *IR* drop in the secondary coil, R_s, and the arc, namely,

$$.038 \times 2550 = 97 \text{ volts},$$

the arc resistance at this point being neglected since it is small as compared to that of the coil.

(12) The secondary current then falls from K to O, as on curve B, Fig. 12, inducing another surge of current in the primary circuit tending to charge the condenser, C_s.

(13) The arc breaks at O, the primary charge surging back and neutralizing.

The arc begins to fail when the rate at which it receives energy becomes less than the rate at which the energy is given to the medium in which the arc occurs. It is evident that the higher the compression, and the longer the arc (i. e., the greater the surface of the arc), the greater would be the rate at which the arc dissipates its heat.

The rate of energy expenditure in the gap probably varies nearly as the square of the current. Hence, to produce a large spark having great disruptive or detonative qualities, it is desirable that the discharge should be bunched, i. e., the time, $Z'O$, should be as small as possible. This would involve, first, a high resistance spark-gap, a primary condenser having as little capacity as possible, no eddy currents or hysteresis, and probably a condenser in the secondary circuit, such as C_s, Fig. 11, such that considerable energy might be stored before the breaking down of the gap. The effect of capacity either in parallel or in series would increase the rate of the secondary discharge, but as capacity in parallel tends to increase the flow of current, and capacity in series tends to increase the voltage, it would seem that a condenser connected as shown in Fig. 11 would be best.

In connection with condensers in parallel it should be noted that the spark-gaps, sometimes placed on the body of the coil to protect it from too high a voltage in case of an open circuit in the wiring to the spark plugs, and to serve as a visual indicator of the open circuit, act similarly to the condenser shown in Fig. 11.

Extra spark-gaps in series, such as the gaps in the secondary distributers, which are used to distribute the sparks from one coil

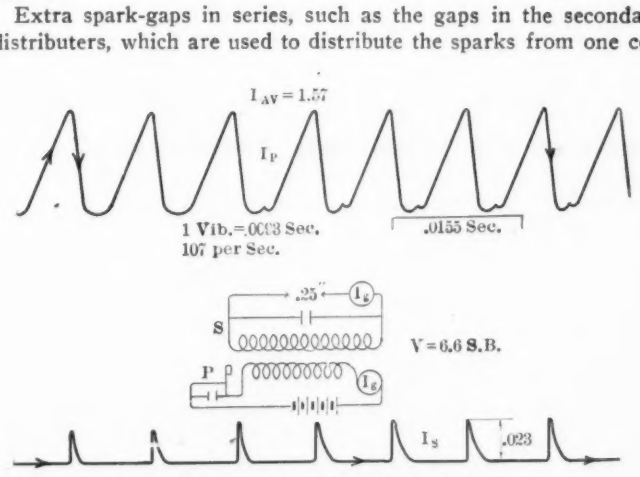


FIG. 19.—OSCILLOGRAPH RECORD.

to several cylinders, and the spark gaps placed in the different circuits to the spark plugs as visual indicators of the operation of the coils, have an effect which may or may not affect the spark in the cylinders. For example, the addition of a gap in series increases the voltage necessary to start the secondary current by an amount greater than the proportional increase in the length of the spark-gap; the extra gap increases the resistance, and hence the discharge rate; it also adds a capacity in series with the secondary circuit which tends to cause the coil to discharge more quickly, and incidentally it absorbs energy.

From the foregoing we may conclude that the jump-spark system of ignition is electrically very inefficient, the efficiency ranging from probably less than 10 per cent, as in Fig. 18, to nearly zero, in Fig. 16.

The principal causes of the low efficiency are: The relatively high resistance of the secondary coil, as compared to the arc; the I^2R losses of the surging currents in the primary and secondary coils independent of the useful currents; the eddy currents resulting from the enormously sudden changes in magnetic flux; core hysteresis; primary coil I^2R losses due to large primary currents; unnecessary sparks occurring after the gas has been fired.

The efficiency of vibrating jump-spark coils could, as a rule, be much improved by constructing them as follows: Use a small iron core of fine insulated iron wire; a low resistance primary, and a relatively low resistance secondary coil; exceedingly quick hammer break vibrator, hitting the core at the same time it makes the break, breaking in oil if necessary; a vibrator which does not chatter; a small mica primary condenser; a high primary voltage with low resistance batteries; a short time of contact in the engine timer, resulting in only one or two sparks for each explosion.

As compared to the touch-spark coil, however, the vibrating jump-spark coil has several things to recommend it. Its primary building up curve, as PM, Fig. 18, is very efficient in storing up magnetic energy in the core; the spark of a jump-spark coil has much greater disruptive and detonative qualities than that of touch-spark coil and hence is much more effective; the igniter lag is usually less; the ignition point is more easily shifted and there is usually less noise.

In case of a mechanical generator, the efficiency of the coil is not of great importance, except in so far as it affects the size and weight of the coil and generator, and the reliability of the system.

The sources of current for jump-spark coils in general must have greater current capacity than for touch-spark coils because of the greater number of sparks and the lower efficiency. The voltage should be constant, at a value of between 4 and 16 volts, depending upon the design of the primary circuit of the coil and its adjustment.

The writer desires to take this opportunity to thank the numerous friends who have kindly assisted in making the experiments outlined herewith. His gratitude is especially due to the Globe Iron Works of Menominee, Wisconsin, for the use of gasoline engines and other apparatus, and to the Gugler Electric Manufacturing Co., of Minneapolis, for the use of igniting apparatus.

Single-Phase Light and Power Work at Centralia, Ill.

Two and three-phase systems have become so commonly used by the larger central stations of this country for carrying on a combined light and power business over large areas that there seems to be a great lack of knowledge among some central station men as to the amount of power business which is being done by stations operating single-phase machinery. There are, of course, a large number of small single-phase electric light plants all over the country. Many of these are beginning to reach out for power business and are establishing day circuits where only night service was previously given. To such the natural course

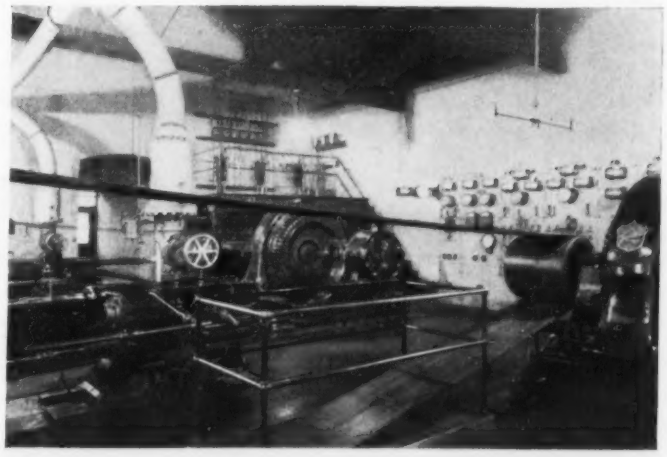


FIG. 1.—DYNAMO ROOM, CENTRALIA SINGLE-PHASE PLANT.

is to use single-phase motors. Single-phase central stations doing a notable amount of power business seem to be more numerous in Illinois than in any other locality. Among the larger single-phase plants in that State is that of the Centralia Gas & Electric Company. This plant, besides being notable as one of the larger single-phase plants, is also remarkable for being one of the neatest and best maintained central stations of the size to be found anywhere.

Being in the midst of a coal mining district where coal is exceedingly cheap and where the screenings burned under the boilers cost only about 50 cents per ton, the type of steam machinery selected was naturally that which would involve the lowest investment consistent with reliability, rather than machinery with high fuel economy. The generating equipment consists of two 200-kw, single-phase, 2,200-volt Bullock alternators running 600 r.p.m. The boiler equipment consists of horizontal return flue boilers. The building is of brick with wooden truss roof and the engine room floors are of hardwood with oil finish. The station is not on a railroad; coal has to be hauled to it by wagons and is unloaded directly in front of the boilers. Fig. 1

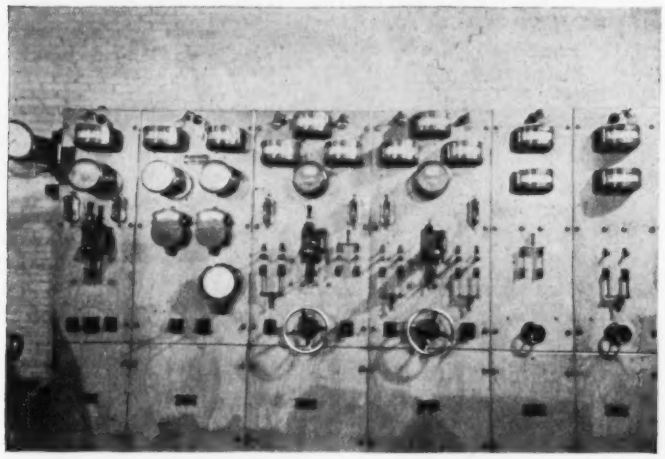


FIG. 2.—SWITCHBOARD, CENTRALIA SINGLE-PHASE PLANT.

shows a view of the engine room. This equipment is about four years old, having replaced a former equipment of Corliss engines belted to a line shaft and driving Warren alternators. The arc lighting is done from constant-current transformers with G. I. regulators.

The switchboard, which is shown in Fig. 2, has a panel for each generator in the middle, a panel for each exciter at the right, a total panel and a feeder panel at the left. The board is provided with two sets of bus-bars. Stfeet lighting transformers are connected to one set of bus-bars, and the commercial lighting and power to the other set, so that the two machines need not be operated in parallel. They are, however, frequently operated in parallel in order to give the engines a better load factor; for example, at certain hours of the day if the dynamos could not

FIG. 3.—ROOM IN BOX AND BARREL FACTORY.

be thrown into parallel one engine would be working on street lighting load only and consequently very much underloaded, while the other engine would have an overload of commercial light and power. A synchronizer is provided at the end of the board as shown. The generator panels are provided with G. I. circuit-breakers, strip, block, fuses, watt-hour meters and an indicating ammeter, voltmeter and wattmeter. The total panel has watt-hour meters on each bus-bar and a Bristol recording voltmeter.

The condition of the belts in this plant is notably good. These belts are four years old and look as if they might be only four months old. The only treatment given them by the engineer in charge is a spoonful of linseed oil occasionally, which, when the size of the belts is considered, amounts to almost no treatment at all. One thing which makes it possible to maintain these belts in such good condition is the fact that practically no engine oil gets on them. The engine shafts are unusually long and the engine fly-wheels are consequently mounted an unusual distance from the governor, eccentric and other parts, which usually throw oil on belts. This one little point is doubtless worth much to the company, both in cost of belt renewals and ability to pull the full rated load of the engine without belt slippage. The generators have paper pulleys.

The maximum load on this station is about 200 kw and the day load varies from 20 to 30 kw with, of course, a drop at the noon hour due to the shutting down of motors. It is hoped to get considerably more power business than has yet been obtained and so improve the ratio of average to peak load. Wagner single-phase motors are used. There are about 36 motors connected for service. One of the most interesting installations is that in a box and barrel factory where a remarkable amount of work is done in a very small building by virtue of the fact that each machine is driven by its own individual motor and can be placed with reference to convenience of handling of material without regard to the position of any line shaft. In fact, it would be hard to find a more striking illustration of the value of individual electric drive than can be found in this little factory. This factory has all together nine motors, the largest of which is 10 hp. Seven of these motors are in one room 30 by 44 ft. Fig. 3 gives some idea of this room. It is almost unnecessary to say that this number of machines could not be operated in such a room to any advantage in a factory equipped with a line shaft.

Most of the motors connected to this plant are those operating intermittently during the day. The addition of a few motors operating industries all day would, of course, materially improve the load factor. The economy of the station at present, because of very cheap fuel, compares very favorably in dollars and cents with some good-sized power plants; but it would be considerably improved by a larger day load. Mr. G. E. Fish recently assumed the management of this company.

LETTERS TO THE EDITORS.

Sodium as a Conductor.

To the Editors of Electrical World:

SIRS:—The article on "The Use of Sodium as Conductor in Place of Copper," by Mr. A. G. Betts, interests me very much. At least eight or ten years ago Mr. Charles S. Bradley pointed out to me the fact that an electrical conductor composed of sodium is much lighter than one of copper or even aluminum for equal lengths and resistances. At the same time he proposed to minimize the practical difficulties involved in the use of such a soft and oxidizable metal by enclosing it in an iron or steel tube with screw plugs or caps at the ends. Of course, it is understood that these conductors would be useful only for direct current. We calculated that the total weight including the protecting tube would still be less than that of an equivalent copper conductor. This is true of the last three conductors in the table given by Mr. Betts, based upon standard wrought-iron pipes, and would be even more favorable if pipes with thinner walls were used, which would seem practicable because the sodium would reinforce the pipe and no considerable internal or external pressure is involved. On page 3 of Vol. 22, of my "Electric Lighting," the first edition of which appeared in 1901, this statement is found: "Metallic sodium is only one-quarter as heavy as copper for equal length and resistance." This follows a similar comparison between aluminum and copper. Mr. Betts finds the ratio to be 37.5:115, or 1:3.07, instead of 1:4. This difference is due to the fact that my quoted statement is based upon a conductivity (by volume) of 37.4 for sodium compared with 100 for silver, whereas Mr. Betts assumes 31.4. The figure used by me is given in "Dictionnaire de Chimie," by Wurz, under "Sodium."

In view of the above facts the editorial referring to Mr. Betts' article ascribes rather too much novelty to this idea; at the

same time full credit is due for actual results and definite comparisons. The price assumed for sodium by Mr. Betts, 7½ cents per pound, is far below present prices and make his results apply to some future time if ever realized. Even if we take 20 cents per pound instead of 7½ cents the total cost of the sodium conductor is less than that of copper because the cost of the iron pipe is a large portion of the total expense. I have not been able to find any figures for the conductivity of lithium, but if approximately equal to that of sodium, the former metal would have even greater advantages in lightness, its specific gravity being only .59 compared with .97 for sodium.

COLUMBIA UNIVERSITY, N. Y. FRANCIS B. CROCKER.

Wireless Telegraph Receiver.

To the Editors of Electrical World:

SIRS:—In your issue of November 3 there is a description of a wireless telegraph receiver by Dr. Lee de Forest, which he has called an "audion." This appliance as described and figured appears to consist of a low-voltage carbon filament glow lamp having two platinum plates embracing the carbon filament and carried on a separate platinum wire sealed through the glass. There is also a connection outside the lamp between this third terminal and one end of the continuous-current battery used to incandesce the carbon filament, a galvanometer battery and telephone being inserted in that circuit. As there is a remarkable similarity between the appliance now christened by Dr. de Forest an "audion" and a wireless telegraphic receiver I called an *oscillation valve,* which was described by me in a paper read to the Royal Society of London on February 8, 1905, and also in one read to the Physical Society of London in May, 1906, and also previously described in a British patent specification, No. 24850, of 1904, and a United States patent specification No. 803684, of 1905, I ask the favor of a little space to mention the nature and mode of use of my oscillation valve that your readers may judge for themselves how far this instrument now called an "audion" is or is not identical with my valve. As far back as 1890 when investigating the so-called "Edison effect" in glow lamps I discovered the unilateral conductivity of the space between the incandescent filament and a cold metal plate held on a platinum wire sealed through the glass, and in November, 1904, discovered that this unilateral conductivity held good for high-frequency currents, which is not the case for electrolytic rectifiers. I then constructed and described the use of a carbon filament lamp having an insulated metal cylinder or plate included in its bulb as a means for separating out the alternations of high-frequency oscillations produced by electric waves and making them readable on an ordinary galvanometer; and described the use of this device as a receiver in connection with electric wave telegraphy both in the above-named papers and specifications and also in my book on "The Principles of Electric Wave Telegraphy," published last May. Dr. de Forest's method of using this appliance as an electric wave detector appears, so far as I can judge from published accounts, to be a little different from mine, but nevertheless the actual construction of the apparatus is the same.

A reference to the above-mentioned papers published by me will show that I employed a lamp made with a metal cylinder or plate embracing the filament as a valve to separate out the opposite constituents of an electric oscillation, and so detect them by a sensitive continuous-current galvanometer. Even if Dr. de Forest has discovered some other way of employing the same device as a receiver, I venture to think that my introduction and use of it should not be ignored, as I believe I was the first to apply this device of a carbon filament lamp with a metal plate included in the vacuous bulb as a means of detecting electric oscillations and electric waves.

LONDON, ENGLAND. J. A. FLEMING.

Racial Engineering.

To the Editors of Electrical World:

SIRS:—I note in your issue of Nov. 17 a letter published under the title, "Swedish Engineers," the chief purpose of which seems to be to show that Sweden produces better engineers than do the other Scandinavian countries. This proposition is doubtless of interest to those concerned, but what I wish to comment on is the incidental statement, contained in this letter, to the effect that there is an "American Society of Swedish Engineers" which has applied for a home in the Engineering Societies' Building, New York. What on earth is the *"raison d'être"* of such a society, may I ask? Also, is the Engineering Building, built to further the advancement of the engineering profession broadly, but particularly for the engineers of America, to be made a Tower of Babel? The members of the above society are, doubtless, eligible for membership either in recognized societies of their own country or of this country; why, then, form a nondescript organization which can make only for race separation, division of interest and weakness generally? Let us welcome as members or as guests of our institutions all worthy engineers from all lands, and let them become Americans or remain foreigners, as they prefer, but for the best interests of all, these "hyphenated" American societies should be discouraged. We have independent societies for Civil, Mechanical, Electrical, Mining, Chemical and what-not engineers, and trouble enough in managing them properly. What results will we get with a separate institution for each nation of the globe in addition?

NEW YORK. F. V. HENSHAW.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Carbon Brushes.—SIEDEK.—An article on the phenomena on carbon brushes. The author shows that the peculiar diminution of the transition resistance on carbon brushes with increasing current is due solely to the formation of elementary arcs near and around the contact points. To confirm this hypothesis the author gives mathematical calculations and a series of curves with special consideration of the phenomena at the arc. In his experiments with carbon brushes sliding on brass slip rings, he succeeded in obtaining for a short period without trouble 120 amp. per square centimeter, using a strong pressure of the brushes against the slip ring.—*Elek. Zeit.,* November 15.

Lamps and Lighting.

Neutral Wire.—DE RYCKERE.—Since the introduction of higher voltages (200 or 225 volts) in Europe, 4 and 5-wire systems of distribution have become antiquated, and therefore only three-wire systems are considered. A great deal of attention has been paid to the calculation of the feeders required for the outer mains, but very little attention has been paid to the study of the neutral wire. Engineers generally make its section half or two-thirds that of the outers. This practice has certain drawbacks. To remedy them neutral feeders, or cross-connections of the neutrals, are often employed. The function of the neutral feeders is quite different from that of the feeders for the outer mains. In the latter case the direction of the current is quite invariable. The phase differences between the feeding points are necessarily equal to the difference between voltage drops in the corresponding feeders. In the neutral feeders the direction of the current is variable, and the phase difference between two feeding points can be the sum of the voltage drops in the two feeders. In order to secure satisfactory working, therefore, the voltage drops in the neutral feeders must be negligibly small. A little consideration will also show that it would be better to omit the neutral feeders altogether, and use the copper in the neutral main. When the central station is situated outside the network it frequently happens that all the feeders follow a common path for an appreciable distance. For the whole of this path we have a neutral wire receiving no current directly from the mains. It is, therefore, a true neutral feeder, and its section can be made

very small, for the variable phase difference between the mains to which this gives rise can always be exactly compensated at the central station by making the two supply phase differences equal. It is possible, however, to make a better arrangement. The station is generally situated at some distance from the center of the network. In this case we can calculate by the ordinary rules the most economical distribution of copper in the neutrals on the supposition that the station is at the center of distribution. We can then incorporate in the network the feeders determined on this hypothesis, and connect the central feeding point of the neutrals with the station by a main of small section, which will be the only neutral feeder. The pseudo-feeders which have been incorporated in the network will have the effect of reducing the quantity of copper required. In a network made in this way the section of the neutral mains increases from the central point to the boundary. In existing networks it will always be advantageous to connect all the neutral feeders to the neutral mains at numerous points. Two methods are proposed when new networks have to be designed. In both methods the neutral point is found, and this is connected to the station by a single neutral feeder, the voltage drop along which may be large, as the balance of the supply phase differences can easily be maintained at the station. In the first method the sections of pseudo-feeders to the neutral main corresponding to the feeders of the outers are calculated. The section of the neutral main will then be calculated on the hypothesis that it uniformly increases with its distance from the central feeding point. It may increase, for instance, from ¼ of the section of the outer mains to ⅓ or ½ their section at the boundaries. Wherever the pseudo-feeders run parallel to one another we replace them by a single neutral main. The second method is more elaborate and accurate. The entire neutral network is divided into sectors, having a common vertex at the central neutral point. Each sector is served by the main neutral artery. These sectors are then subdivided into bands, each band being served by a smaller artery, and so on. The calculations are then made, beginning at the central point.—*Science Abstracts*, September 25; from *Ass. Ing. El. Liege, Bull.* 6, March-April, 1906.

Zirconium Lamp.—A note on the new "Z" lamp, which is built by the Zirconium Lamp Company for voltages from 1.5 to 220, with an approximate power consumption of one watt per hefner candle. For voltages of 110 the lamp is made for 35 hefner candles or more, for 220 volts for 70 hefner candles only. No exact information is given on the composition of the filament. In the prospectus of the company it is claimed that the life is from 500 to 1,000 hours without appreciable diminution of the candle-power during this time. It is also claimed that the lamps do not blacken. The following results were obtained in practice with the new lamps. An experiment with 110-volt, 56-cp lamps gave bad results. Most of the lamps were destroyed in less than 150 hours, and some became quite black during this time. A somewhat better result was obtained with the 110-volt, 35-cp lamp. Three lamps were selected from one shipment. Of these the first had a life of 350 hours, the second 450 hours, no appreciable diminution in the candle-power being observed during this time. The third lamp alone is still in service, having been operated now for 600 hours, but it is already considerably blackened. It therefore seems that the average life of 500 hours claimed by the company is too high.—*Jour. f. Gasbel.*, November 10.

Indoor Illumination.—Swinburne.—For indoor illumination the important point is that the eye should receive plenty of diffused light from the objects that are to be observed, and as little light as possible from any other source. It would be almost impossible to light a public or any other building economically entirely by diffused light, with all the lamps out of sight, but the evil of direct lighting can be very much reduced by arranging the lamps so that they are high enough not to shine directly into the eye, except from a good distance, and so that they are small as to candle-power and large in area and give a diffused light. Artificial light should approach daylight as much as possible. In drawing-rooms and ballrooms, however, yellow light is advantageous. Too much stress is generally laid on getting the greatest candle-power at a given expense. It is improper to have 10,000 cp in a large room if one can really see better with 1,000 cp properly arranged. Data are given on the comparative cost of different lamps and the inherent difficulties of making such comparisons are pointed out. Broadly, it may be said that gas lighting with mantles is very much cheaper than any form of indoor electric lighting except the mercury lamp. There are other questions, however. One is that of health. Gas uses up the air. In places where there is neither electric or gas supply there is a great opening for acetylene. Acetylene is cheap, taken in candle-hours per shilling's worth of carbide, but, of course, the generator needs attention, and the foul lime must be gotten rid of in some way.—Lond. *Elec. Rev.*, November 16.

Mercury Vapor Lamps.—Schenkel.—An account of experiments with the mercury vapor lamp in a magnetic field. The author studied especially the Hall effect and the cathode rays.—Lond. *Elec.*, November 9.

Power.

Electricity in Belgian Collieries.—Wadou.—An account of the electric equipment of the Esperance and Saint Nicolas pits in the Liège district. The power station contains three steam-driven 180-kw sets, generating three-phase currents at 1,000 volts at 44 periods, and running at 125 r.p.m., and a 750-kw, turbo-generator running at 2,600 r.p.m. At Saint Nicolas the cages are hoisted by an electric winding plant with a Koepe pulley 10 ft. in diameter, the rope speed being limited to 38 ft. per minute; the rope itself has the form of a flat cable. A separately excited 500-volt continuous-current, direct-coupled motor develops the necessary 320 hp, running at 64 r.p.m. The terminals are in direct connection with those of the dynamo of an Ilgner fly-wheel converter, an overload circuit-breaker for 1,500 amp. maximum load being in the circuit. Both the dynamo of the Ilgner set and the winding motor receive their exciting current from an 18-kw, shunt dynamo running at 820 revolutions, which is driven by a 27-hp induction motor. The motor of the Ilgner set is capable of developing 250 hp; the fly-wheel is 13 ft. in diameter and weighs 40 tons. The brakes for the Koepe pulley are applied by compressed air, which is obtained from a compressor driven by a 5-hp, 120-volt, three-phase motor. A ventilating fan 5½ ft. in diameter is coupled with two three-phase motors of 30 hp and 50 hp; these are able to drive the fan at speeds of 210, 270 or 320 revolutions, the capacity being 700, 875 and 1,050 cu. ft. per second, respectively. The water pump is coupled to a three-phase induction motor of 125 hp running at 330 r.p.m., reduced to 70 on the pump. The capacity of the pump is 2,600 gal. per minute. Several other motors, aggregating 45 hp, are provided for auxiliary purposes. In the Esperance mine an auxiliary hoist is provided down the ventilating shaft, worked by a Koepe pulley also, by means of a 120-hp, three-phase induction motor. Ventilation is provided by a fan of 23 ft. diameter, driven by a three-phase motor of 75 hp; the capacity of the fan is about 1,250 cu. ft. per second. The water pumps are of the same style as those in the Saint Nicolas mine. Other motors, amounting to about 40 hp, are installed for various purposes. A third colliery in the neighborhood is to be fitted up with electric machinery, as a result of the great advantages obtained in the other collieries. The working expenses also have been found to be lower than those of the old steam plants.—Abstracted from *Electro* in Lond. *Elec.*, November 16.

Electric Pumping for Hydraulic Presses.—Orban.—A description of an electrically-driven pumping plant for operating hydraulic presses, at a works at Louvain. The pump room contains five twin cylinder double-acting pumps running at 60 r.p.m., each driven through a combination of belt and spur gearing by an 85-hp continuous-current motor running off a 500-volt circuit at 100 r.p.m. The chief point of interest in the installation is the method adopted of automatically starting and stopping the motors according to the level of the hydraulic accumulator. Four of the pumps are provided with automatic starting gear, but the starter of the remaining one is worked by hand. The control apparatus is collected together on a marble switchboard with six panels. On the first of these is placed the hand-operated starter and circuit-breaker belonging to the stand-by set, while the next four panels contain the groups of electromagnetically actuated switches which form the starters for the other four motors. These electromagnetic switches are operated by drum-type controllers situated at the bottom of each panel. The remaining panel contains various main switches, instruments, etc., and at its

base the mechanism which automatically puts in action the starting controllers of the various motors. Two horizontal screw-threaded shafts run across the panel. One of these is driven by chain gearing by the hydraulic accumulator in such a way that the position of a traveling nut mounted on it corresponds to the amount of water in the accumulator, and the other carrying a similar traveling nut, is driven at a constant speed by a small auxiliary motor. This latter shaft is also geared through a reducing gear to another shaft upon which are mounted the drums of all the motor controllers. These are normally free on the shaft, but are provided with magnetic clutches. The traveling nut on the constant-speed shaft is provided with a thread round only half of its circumference, and is fitted with a weighted lever which normally keeps it in engagement with the screw. A projection on the traveling nut on the other screw, however, lifts this weighted lever whenever it has approached within a certain distance, and disengages the half thread, and approaching still further carries the nut on the front shaft with it. The latter also carries a contact brush which moves over the contacts on the board itself, which put in circuit the magnetic clutches of the controllers. These contacts are so arranged that the motion of the contact nut from left to right—that is to say, the direction in which its own screw drives it—energizes the magnetic clutches in succession, and thereby starts up the four motors one after the other, while its motion in the reverse direction—that is, when brought back by the other nut—stops the motors by releasing the clutches. Thus the front shaft is, so to speak, always trying to start more pumps, and the back shaft, as the accumulator rises, endeavors to stop them, so that the number of motors running depends on the amount of water in the accumulator. A ratchet prevents each controller from overrunning, and a weight attached to a cord moving over a pulley returns each one to its normal position as soon as its clutch is free. Owing to the constant speed of the controller shaft, the motor resistance will always be cut out at the same rate, no matter how fast the accumulator empties, and it is impossible for one motor to be started up before the previous one is up to speed, as the starting nut moves forward at a constant speed when once started until it overtakes the controlling nut, so that excessive rushes of current are avoided. In the installation described the accumulator can be completely filled in two minutes, and the time taken to start each motor does not exceed 14 seconds with a running current of 110 amp. each and a starting current rising to about 300 amp.—From *Bull. Soc. Belge d'Elec.;* abstracted in Lond. *Elec.,* November 9.

Electric Pumps in Mines.—A report of tests made on electric pumps at the Franziska mines near Witten, Germany. The generating station contains three steam-driven, three-phase alternators, giving 145 amp. at 2,000 volts. Each generator supplies current for one of the three motors driving the three pumps. These are three-phase induction motors with squirrel-cage armatures running at 2,000 volts and 25 periods, and 80 r.p.m., and giving 550 hp when consuming 150 amp. The tests were made under ordinary working conditions, no special repairs having been made for the tests. The results are given in great detail in tables and diagrams. The total efficiency of the pumping plant is about 67 per cent.—*Glückauf,* September 29.

Power Transmission.—HERZOG.—The first part of an illustrated description of the power transmission line from Brescia to Caffaro, in northern Italy. There are four Pelton wheels, each of 2,500 hp, the generators giving 150 amp. at from 9,000 to 10,500 volts, the frequency being 42.—*Elek. Bahnen,* November 14.

Gas Analysis for Steam Users.—KERSHAW.—The first part of a serial on analysis of the waste gases in steam plants. The first part deals with the physical and chemical characteristics of the waste gases and methods of taking samples.—Lond. *Elec.,* November 16.

Cranes.—KOLBEN.—An illustrated description of the use of electric cranes in metallurgical works and rolling mills.—*Elek. Bahnen,* November 3.

Traction.

Manganese Steel Rails.—A note on Hadfield's manganese steel which is non-magnetic and is much used in special track work for tramways and railways. Its specific resistance with direct currents is higher than that of ordinary steel. Comparing the net fall of potential between the ends of similar bars of manganese and ordinary steel when traversed by alternating currents, it becomes an interesting question as to how far the non-magnetic quality of the manganese steel counteracts its increased electrical resistance. Preliminary experiments made by Wilson with bars, each 1¾ in. in diameter and 10 ft. long, give the following ratios when traversed by a current of 200 amp. at a frequency of 43:

Ratio	Resistance to direct current.	Net fall of potential.	Watts dissipated.
Ordinary steel to manganese steel..	0.31	3.5	2.9

The tests are, therefore, in favor of the use of manganese steel for rails traversed by alternating currents.—Lond. *Elec.,* November 16.

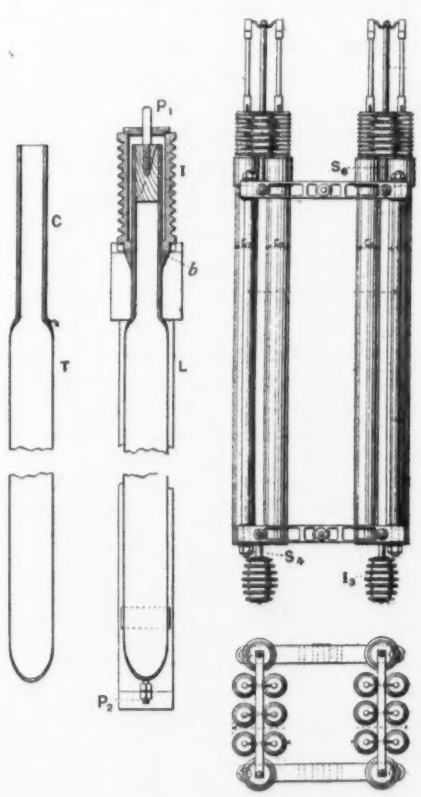
Rails.—JOB.—A paper read before the New York Railroad Club on steel rails, discussing the structure of different kinds of rails and considering the defects to which they are liable.—*St. R'y Jour.,* November 24.

Insulators.—HAKANSSON.—An illustrated description of new tramway insulators especially designed for high-tension roads.—*Elek. Bahnen,* October 13.

Automobile Omnibus.—VELLGUTH.—An article giving figures on the operating costs of the modern auto-bus from German or English practice, with tables of estimates of the cost of service under certain conditions. It appears that the cost per passenger-mile is a little above 3 cents, which is higher than the cost of the passenger-mile on even the smallest railway systems.—*St. R'y Jour.,* November 24.

Installations, Systems and Appliances.

Condensers.—GUILBERT.—An illustrated description of high-tension condensers made by a Swiss firm. The construction is shown in Figs. 1 to 3. The condenser consists of a glass tube, *T* (Fig. 1), with a neck, *C*, at one end, the glass of the neck being



FIGS. 1, 2 AND 3.—CONDENSERS.

three or four times thicker than the rest of the tube. The inner and outer condenser plates consist of very thin silver layers chemically deposited on the glass. Above this, thicker layers of copper are deposited to provide the necessary consistency. Each condenser element has an upper contact, P_1, which is connected with the inner metal deposit, and a lower contact, P_2, connected to the outside deposit. Each condenser element is then placed in a glass tube, *L*, as shown in Fig. 2, *b* being a caoutchouc block, and *I* a glass insulator. The space between the outer brass tube and the glass tube is filled with a mixture of water and glycerine. Fig. 3 shows the arrangement of 12 condenser cells

of the following constants: Capacity, 0.077 microfarad with an apparent power of 2,400 volt-amperes for a tension of 10,000 volts at the terminals. Various applications of such condensers are described, especially for the supply of leading wattless currents, starting of single-phase induction motors; the protection of networks against atmospheric discharges, the protection of tramway motors, and for purposes of tuning in wireless telegraphy.—*L'Eclairage Elec.*, November 10, and *L'Industrie Elec.*, November 10.

Single-Phase Currents from Three-Phase Supply.—Still.—An article illustrated by diagrams. The author first considers briefly the results of taking only single-phase current from a three-phase generator by utilizing either one, two or three of the armature windings. He then discusses the use of transformers for obtaining single-phase supply, the following three cases being dealt with. In the first case the primary current is taken from one phase only, the transformer being of the ordinary single-phase type. In the second case a transformer is used with three cores, all of which are wound as usual. The author shows that in all cases where the three-phase load is large relatively to the single-phase output, it is advantageous to use an ordinary single-phase transformer connected across one phase only for providing the single-phase current. The author finally discusses the losses in the generator when supplying three-phase and single-phase currents simultaneously.—Lond. *Elec.*, November 9.

Electricity in Chemical Factories.—An illustrated description of the electric installation of a chemical works. The lighting circuit is separate from the power circuit. For lighting, direct current is used, the generator working in parallel with a battery. For power purposes three-phase currents are used, induction motors being employed throughout, the smaller ones with squirrel-cage armature, the larger ones, above 5 hp, being provided with slip rings and brushes. Electricity is also transmitted to two cottages for lighting.—*Elek. Anz.*, November 15.

Electro-Chemistry and Batteries.

Storage Batteries.—Cowper-Coles.—The conclusion of his paper on recent improvements in storage batteries. In the present installment the author deals especially with solid network cells and describes the Panthode battery and the Niblett battery.—Lond. *Elec.*, November 16.

Battery Capacity.—Loppe.—The author refers to a former article of Faure-Munro on the calculation of the capacity of a storage battery with a varying load. The present author shows another derivation of the same results.—*L'Industrie Elec.*, November 10.

Units, Measurements and Instruments.

Magnetic Tests of Iron.—Campbell.—An illustrated description of the Picou permeameter. The course of the magnetic flux during the test is shown in the two diagrams of Fig. 4. The

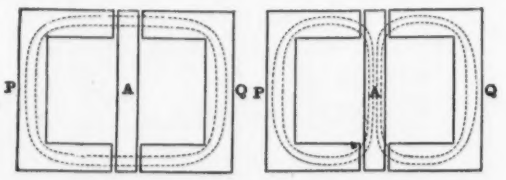


FIG. 4.—MAGNETIC TESTS OF IRON.

sample to be tested is in the form of a rod (or bundle of strips), A, of rectangular section, and is clamped between the iron yokes, P and Q. These yokes are wound with equal magnetizing coils, and A is surrounded by an evenly-wound solenoid, which can receive current from a circuit independent of those for P and Q. Let these circuits be designated the test primary and the yoke primaries, respectively. On A, P and Q are also secondary windings, which can be connected to a ballastic galvanometer calibrated to measure flux-density. An ammeter is inserted in each primary circuit, and the number of turns in the test primary is arranged so to to make H a simple multiple of the current—viz., $H = 200 I_1$. The currents are used relatively small, the maximum value of I_1 being of the order of from 0.5 to 1 ampere. The method of testing comprises three different steps. First, a small current, i_1, is passed through the yoke primaries connected in series in such a way that the magnetic circuits of the yokes are in series, giving flux as shown in the left-hand diagram. The yoke flux is then gauged. The second step consists in reversing the connections of one of the yoke primary coils, without altering the current, i_1. This change of connection causes the distribution of flux illustrated in the right-hand diagram. A small current, I_1, is then sent through the magnetizing coil of the bar, A, and gradually increased until the gauge has been brought back to the value it had in the first step of the test. Since the magnetomotive force of i_1 overcomes the reluctance of the yokes, the four joints and the two short paths in each end of A, the magnetomotive force caused by I_1 produces the nearly uniform flux in the bar, A, so that the corresponding H is at once known. Now follows the third step: The secondary coil on the rod is connected to the ballistic galvanometer, and both I_1 and i_1 are simultaneously reversed. From the resulting throw the flux in the bar, and hence B can be at once determined. Thus a pair of corresponding values of H and B are obtained. The yoke current, i_1, is then altered and by repeating the above operations, a second point on the B-H curve is found, and so on until the complete curve has been drawn. The following zero method is used for gauging the yoke flux. The primary circuits of the yokes are in series with the primary of a small transformer whose magnetic circuit has a small variable air-gap that can be delicately adjusted by means of a screw with a milled head. The secondary coil of this transformer is in series with the yoke secondaries, but in reverse direction, so that its induced e.m.f. opposes theirs. If this composite secondary circuit be connected to a galvanometer, for a definite value of the yoke primary current the air-gap can be so set that there is no throw of the galvanometer needle when this current is reversed; and as long as the air-gap is left in that setting, the combination forms a ready means of gauging the yoke flux and ensuring that its value in the second stop of the test has been brought exactly to what it was in the first step. Applications to tests of iron and steel are described.—Lond. *Elec.*, November 9.

Selenium Cell.—Reinganum.—A description of a new arrangement of a selenium cell. Ordinary selenium cells have the disadvantage that the contact points between selenium and metal cannot be illuminated sufficiently and with sufficient exactness. Uljanin formerly used an arrangement in which a thin layer of selenium was placed between two transparent platinized glass plates, the latter serving as connections to the circuit. The illumination was perpendicular to the surface of the glass plates. Uljanin observed quite strong electromotive forces occurring with illumination and reaching 0.12 volt in sunlight. The direction of the e.m.f. was so as to produce a current in the direction of the passage of the light. This type of cell has not found practical application, since the thin platinum layers have a very high resistance so that the current produced is very small. The present author covers one side of a platinum sheet with selenium and places it as an electrode into an electrolyte of sulphurous acid or hydrochloric acid (the other surface of the plate being covered with paraffine). A plain platinum plate is used as the other electrode, but it is either made in the form of a platinum screen or is placed perpendicular to the other selenium electrode in order to permit the light to fall perpendicular on the latter. With a selenium electrode surface of about 1 square centimeter, currents of about one-twentieth milliampere are obtained. The selenium layer is produced on the plates by first moistening the platinum sheet with water and then subjecting it for a short time to the dark-green vapors of fused selenium. The plate is then heated in air to about 180° C., whereby the selenium layer is changed into the gray modification which shows metallic conduction.—*Phys. Zeit.*, November 1.

Phase Displacement in Resistances.—Drysdale.—In continuation of his serial on methods of measuring small phase differences, the author gives the results of tests on the phase displacement in resistances. In almost all cases where liquid resistances, other than with aluminum electrodes, are employed, the power factor is unity within half of 1 per cent. of less. In the case of regulation tests of dynamos, however, the two or three degrees of lead introduced may quite appreciably improve the regulation of an alternator above that on an absolutely non-inductive load. Iron-wire coils are very appreciably inductive at ordinary frequencies, and much better results should, there-

fore, be obtained in the starting of induction motors with ironless coils, or, better still, with liquid resistances. The large angle of lead produced with aluminum electrodes might make them of decided value for induction-motor starters.—Lond. *Elec.*, November 16.

Phase Difference of 90 Degrees.—MUELLENDORFF.—A brief note in which the author shows that a phase difference of exactly 90° may be produced between two alternating currents shunted from the same main circuit, without the aid of any capacity, if use is made of their mutual inductance. The formulas of the case are given.—*Elek. Zeit.*, November 15.

Star Resistances.—STILL.—An article illustrated by diagrams giving some notes on the calculation of star resistances for three-phase instruments.—Lond. *Elec. Eng.*, November 9.

Telegraphy, Telephony and Signals.

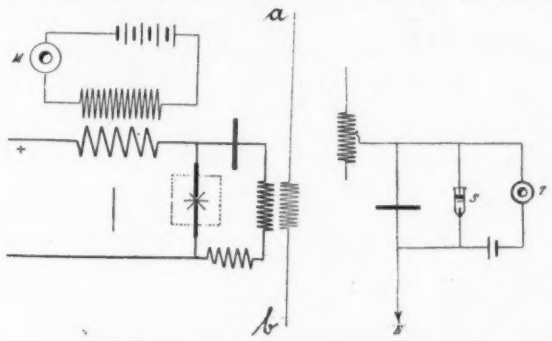
Cable.—VANONI.—An illustrated description of the telegraph and telephone cables of the Simplon tunnel. The length is over 13 miles, of which about 12 miles are in the tunnel. It is proposed to use each separate conductor for telegraphic and each pair for telephonic purposes. The latter will form part of the trunk circuits between Berne and Lausanne on the Swiss side, and Milan, Turin and Genoa on the Italian side. Hence special consideration was given to the form of the cable. A section is exhibited in Fig. 5. Each conductor consists of three copper

FIG. 5.—CABLE.

wires twisted (total section 2.35 sq. mm.). A fine iron wire is spiralled round the copper conductor. The sheaths of Manila paper are triangular in section, and the air-spaces are large. There are two metallic sheaths, the first consisting of 97 per cent lead and 3 per cent tin, the second of pure lead. The latter is covered with two bands of asphalted paper, then jute similarly treated. The iron guards are next laid on, the joints being asphalted, and finally two servings of jute which has been also treated. The conductor resistance is 7.45 ohms per km.; the insulation was 2,000 megohms per km. in the factory, and 1,000 when laid; the capacity to earth, 0.078 mf. per km., and between members of pairs, 0.05 mf.; the self-induction, 0.007 per km. The coefficient of attenuation for 1,000 periods is 0.022. For aerial circuits of 3, 4 and 5 mm. if the ohmic resistance is taken into account, with an insulation of 1 meg. per km., and distance of 25 cm. between the two wires, it is found that the attenuation coefficient is 0.0047 for a 3-mm., 0.0030 for a 4-mm., and 0.0020 for a 5-mm. wire. It was calculated for 1,000 periods that good speech is no longer possible if the product of the coefficient of attenuation and the length of the loop in km. amounts to 2.5. The manufacturers arrived at the following results affecting the choice of gauge for a telephonic circuit between Lausanne and Milan and its subsequent extensions. If this circuit, which is 300 km. long, were made of 4-mm. bronze, then extensions could be made of 230, 364 or 537 km. of 3, 4 and 5 mm. diameter wire, respectively. If, however, for the first mentioned circuit of 300 km. bronze wire of 5 mm. were used, then there could be added lengths of 294, 463 or 685 km., according as this added wire is of 3, 4 and 5 mm. diam. Hence for the circuit Lausanne-Milan 5-mm. wire was adopted. Joints are made in cast-iron boxes, furnished with air nozzles, securely closed when not in use. These are enclosed again in boxes or sleeves of bronze, and the space between the two boxes is filled with compound. The cable is buried in sand to a depth of 30 cm. A row of bricks separates it from the railway high-tension cables. Slabs of granite are placed on top of the sand at track level. There are 24 joints in all.—*Science Abstracts*, September 26; from *Jour. Tel.*, April, May and June.

Telegraphy.—A description of the method of Bogni which doubles the speed of transmission obtainable with the Morse system with only small changes of equipment. The fundamental idea is to suppress the use of three, four or five signs for the transmission of one letter. In the Morse alphabet there are 16 letters requiring four signs, and 3 letters requiring five signs. The reduction in the number of signs transmitted in the Bogni system is obtained by using on the recording strip side by side with the line of dots and dashes of the Morse system a second line so that single or double signs may be transmitted at will.—*L'Industrie Elec.*, November 10.

Wireless Telephony.—RUHMER.—As was recently noticed in the Digest, Poulsen has succeeded in producing undamped electric oscillations for wireless telegraphy; the present author says this makes wireless telephony at once possible. Like Poulsen he uses a direct-current arc lamp in a hydrogen atmosphere. Fig. 4 shows the arrangement of the transmitter. In his first experiments *a b* was not used as vertical wire, but was in the form of a closed circuit containing a brush-light oscillograph tube. By speaking into the microphone, *M*, a corresponding picture of the sound vibrations was obtained by means of a rotating mirror from the oscillograph tube. To use this arrangement as a transmitter for wireless telephony, it is only neces-



FIGS. 6 AND 7.—WIRELESS TELEPHONY.

sary to arrange *a b* in the form of a vertical wire as shown in the illustration. The receiver is shown in Fig. 7, where *S* is an electrolytic wave-detector, *T* a telephone. The author has so far made experiments only in the laboratory, with vertical wires *a b* of about 1.5 meter length. He was able to transmit speech over a distance of 30 meters very clearly.—*Elek. Zeit.*, November 15.

Undamped Electric Oscillations.—Some notes on Poulsen's method of producing undamped electric oscillations for wireless telegraphy, which has already been noticed in the Digest. The arc is produced in a closed box of cube form, into which the two insulated electrodes are introduced through opposing walls. Hydrogen gas is continually fed into the box. The anode consists of a copper ring, *a* (Fig. 8), which is easy to exchange,

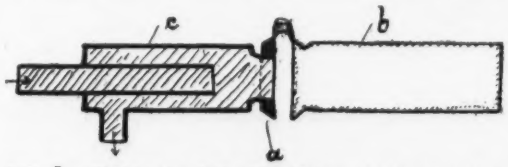


FIG. 8.—ELECTRODE FOR UNDAMPED OSCILLATIONS.

while the cathode, *d*, is of carbon. The copper ring which forms the anode is mounted on a cooling device, *c*, through which water is passed. By means of a small motor the cathode is very slowly rotated so that the arc is formed always at new points of the electrode, which is of importance for the regular maintenance of the oscillations.—*Elek. Anz.*, November 8.

Telephany.—DELAND.—In a continuation of his serial on the development of the telephone service, the author covers especially the progress made in the end of the 70's.—*Pop. Science Monthly*, December.

Miscellaneous.

Discrepancies from Ohm's Law.—BRANDES.—Such conductors (for instance, gases, electrolytes, etc.) or combinations of conductors, which do not obey Ohm's law, show a unipolar effect and a rectifying effect which may be utilized for the construction of wave detectors in wireless telegraphy. Whether such an ar-

rangement is more or less suitable for this purpose may often be predicted from determining the characteristic voltage current curve.—*Elek. Zeit.*, November 1.

The Bastian Mercury Lamp.

In a recent paper before the English Institution of Electrical Engineers entitled "The Mercury Arc and Some Resultant Problems in Photometry," Mr. C. Orme Bastian described in detail the interesting mercury lamp of his invention, which is stated to be entering into considerable use in Great Britain. The lamp is shown in one style in Fig. 1 and in another form in Fig. 2.

When made for the standard English lighting pressure of 200-250 volts direct current the "burner" consists essentially of a ⅛-in. diameter bent glass tube made from hard Jena combustion tubing 10 in. long, the leading-in wires consisting of platinum entering at each end. The platinum leading-in wires are flattened into a rivet head on both sides of the glass; when the tube is hot the greater expansion of the platinum closes up the hole, while when the tube cools the greater contraction of the platinum brings the rivet heads into play, causing them to grip the glass and effectually seal the aperture.

The electrodes are both of mercury and are normally connected by mercury, which is in sufficient quantity to fill the tube between them. On current being switched on the solenoid above pulls up a soft iron armature attached to the tube holder, which tilts the tube and causes the mercury to separate and thus strike the arc at a definite point and then run back into the bulb at the positive end. The arc is made to strike at this definite point by arranging the greater head of mercury above the negative terminal.

In other types of mercury vapor lamps the mercury is carried by evaporation from the negative at the bottom to the positive at

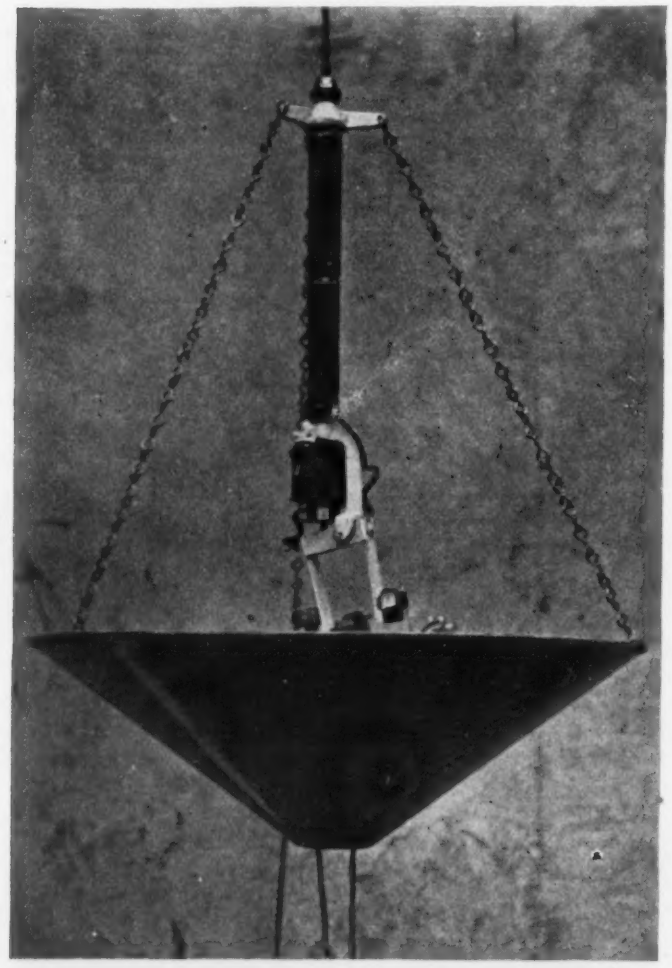


FIG. 1.—BASTIAN MERCURY LAMP, OFFICE PENDANT TYPE.

the top, where it condenses and runs back, but in the Bastian lamp the tube is too small to permit of this action, and dependence for correct distribution of the mercury is placed on the balance between the effects of the electrical and the heat potential. The positive mercury surface is larger than the negative and the current density being thus smaller this surface is cooler and con-

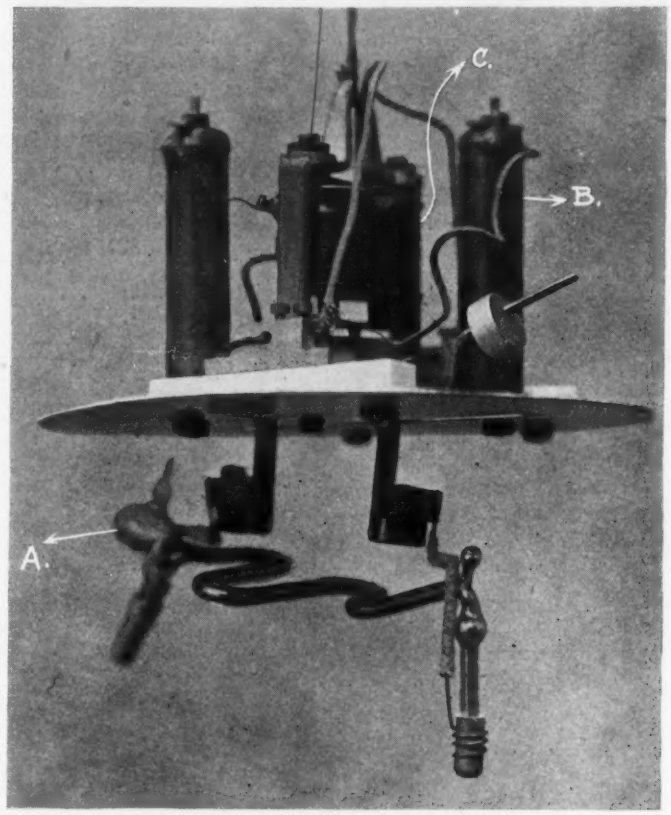


FIG. 2.—MECHANISM OF THE BASTIAN LAMP.

densation occurs at it; on the other hand, the negative surface being very small, gets quite hot and vaporization of the mercury occurs. This, therefore, counteracts the effect of electrical potential, which is to carry mercury in the opposite direction, viz.: from positive to negative.

By so shaping the tube that as the mercury collects at the positive the electrode surface is thereby moved further from the cooling effect of the mass of mercury in the large positive bulb (*A*, Fig. 2), condensation is retarded, and a balance is automatically arrived at and maintained, the effect being strengthened by a reverse action occurring at the negative. The two long porcelain tubes, *B*, are wound with the series resistance and the two small solenoids, *C*, are also in series with the lamp and serve to draw up the armature, and tilt the tube when starting.

It is stated that the Bastian lamp takes from 0.3 to 0.4 of an amp. at 200 to 250 volts, an dconsumes 0.4 watt per candle. In order to counteract the unfavorable quality of the light, supplementary incandescent lamps are used, which brings the consumption to the neighborhood of 0.8 watt per candle, including resistance losses. The total resistance losses are about 20 per cent and any attempt at economy in this direction leads to instability of the arc. The same tube is used for 200 or 250 volts direct current, the only difference being in the amount of series resistance employed.

A Bastian lamp made for 220 volts will stand variations in voltage between 300 to 160 volts without damage. At the higher voltage considerable heat is evolved, and the temperature is such as Jena glass will alone resist. The lamp is stated to operate at the lower voltage without instability and the light emitted within the limits of 160 to 300 volts may be taken as varying from the normal approximately in proportion to the voltage variation.

The standard type of lamp (without its carbon filament lamp) gives the mercury lines, namely yellow, green and blue, and a faint violet, but the yellow is very pronounced owing to the high temperature of the arc. Some experimental lamps are now being tried with the addition of cadmium to the mercury, which gives good lines of red, yellow, green, olive green, three blue and one violet, while the addition of a trace of sodium renders the light quite normal. It is of interest to note that in all the above cases

the color is evenly and steadily distributed throughout the whole tube, and does not occur in patches.

About 3,000 Bastian lamps are now in use and are chiefly used in combination with a carbon filament lamp to produce a light so close to daylight that they are widely used for color matching and decorative purposes in addition to their other ordinary uses. They are also of great value in microscopic work and photography. Bastian lamps are now being used for illuminating the clock tower in the Houses of Parliament, a rhodamine screen being interposed between the lamp and the clock face, the action of the rhodamine being to introduce the necessary amount of red into the light to render the lilumination white without the use of incandescent lamps. Another use is for illuminating street signs and advertisements, since by adjusting the series resistances in the neighborhood of the critical point the arc becomes unstable and may be made to start and stop at accurately timed intervals. The life of this lamp is stated to be about 10,000 hours and the only part then requiring renewal is the glass tube.

The illustrations show the latest type of lamp arranged with the "office pendant." It is also mounted in a great variety of ways for various other indoor and outdoor applications.

The sole licensees to work the patents in France and Spain have been acquired by the Compagnie Generale d'Electricite, of Paris, and in Switzerland the sole license is held by the Schweiz Gluhlampen Fabrik, of Zug. An American company has acquired an option to purchase all the rights in the United States and Canada.

New Benjamin Outlet Box Receptacle.

The Benjamin Electric Manufacturing Company, of Chicago, has just brought out a receptacle for use in standard round outlet boxes. A strong feature of this receptacle is that the binding posts are so situated on each side of the receptacle that the wires

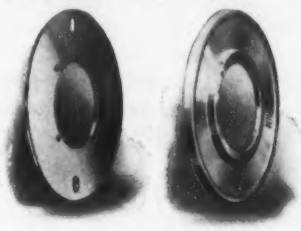
FIG. 1.—OUTLET BOX RECEPTACLE.

can be run almost straight through the box without necessitating a great amount of slack wire. Fig. 1 shows the receptacle proper, while Fig. 2 shows it placed in the conduit box. Binding screws are accessible from the front. It is not necessary to reverse the receptacle to make connections, and the connection is made to the line wire without cutting it or running taps from it. Fig. 3

FIG. 2.—RECEPTACLE IN OUTLET BOX.

shows the steel plate cover for the outlet box through which the porcelain receptacle projects slightly. Over this steel plate cover a polished brass cover, shown in Fig. 4, can be used if no shade holder is desired, but if a shade holder is wanted the polished brass cover with a shade holder spun thereon, as shown in Fig. 5, is used. This makes a very substantial form of shade holder, and, in fact, is a neat job all the way through.

An interesting application of these boxes is to be made in



FIGS. 3 AND 4.—COVERS.

FIG. 5.—SPUN SHADE HOLDER.

the lighting of the Port Huron tunnel of the Grand Trunk Railway. In this installation every effort is being made to keep the wiring installation waterproof. Fig. 6 is a longitudinal section through the outlet box to be used in this tunnel. The box is to be of cast iron with the conduit screwed into it to make a water tight joint. The steel plate cover will have a rubber gasket placed under it, this gasket extending from the outer edge to the central hole through which the bushing protrudes. It

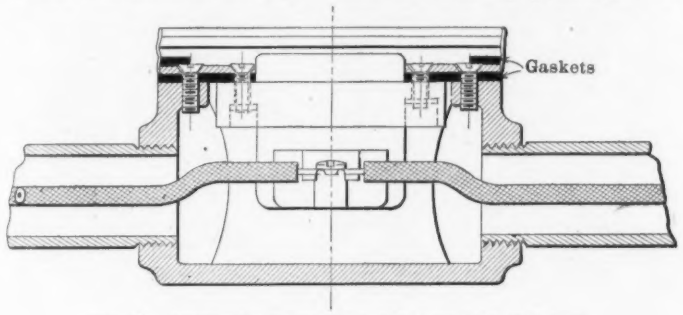


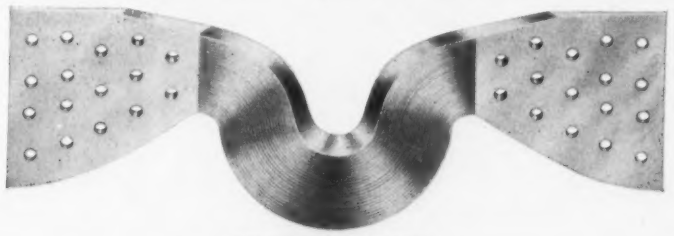
FIG. 6.—RECEPTACLE BOX FOR PORT HURON TUNNEL.

thus acts to keep out moisture not only under the outer edges of the steel plate, but around the bushing. Attached to the steel plate will be a holder into which a vapor tight globe can be screwed against the rubber gasket. As to whether this globe will be used or not is uncertain, as it may not be necessary with such a tight box.

Soldered Rail Bonds.

Railroad engineers have for a number of years recognized the desirability of using a soldered rail bond, but have experienced serious difficulty in soldering the bond properly to the rail and in the tendency of the bond to peel off, caused by the difference in the coefficient of expansion of the steel and copper. Mr. Walter G. Clark in experimenting with the bonds found that if the terminals were made sufficiently thin the copper would expand and contract without any peeling tendency. He also found that if the bond terminal was provided with openings for the admission of solder and the escape of gas, the solder flowed well between the rail and bond terminal and united the bond to the rail thoroughly, overcoming the difficulties heretofore experienced.

The bond on which a patent has been granted to Mr. Clark is made up with perforated or open space terminals which permit



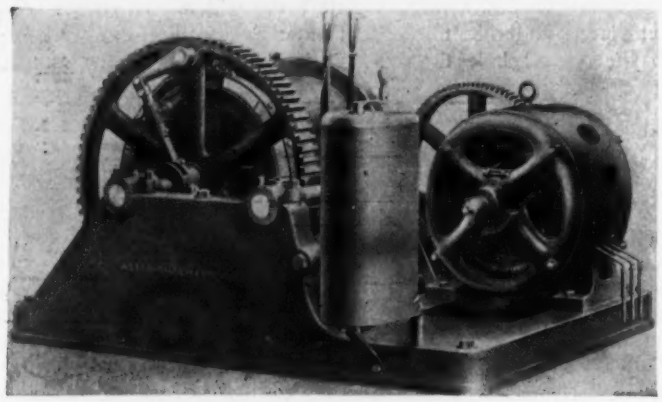
SOLDERED RAIL BOND.

the gases from the flux or soldering salts to escape, and enable the solder to flow well under the bond. The terminals are also increased in area and reduced in thickness to a point where the expansion and contraction do not pull them loose from the rail. These rail bonds are manufactured by the Clark Electric & Manufacturing Company, 135 Broadway, New York City.

Electrically-Driven Mine Hoist.

The electric motor-driven hoist shown herewith has been designed especially to meet the severe operating conditions existing in mines. It is heavily and substantially built, conveniently and compactly arranged and is well adapted to its work. The mechanical details will be appreciated from a study of the illustration and they need not be described. It should be stated, however, that this type of hoist gives as good results as a steam-driven machine; it is just as readily controlled, and as little liable to get out of order.

The controllers used with these hoists are of the drum type, similar to those in common use in street car service. On all single drum hoists the motor is not reversed, but on double drum hoists the handle or lever of the controller not only controls the speed, but also reverses the motor, and is locked in the off position. The controller is securely attached to the frame of the hoist, and the lever is so located as to be conveniently reached



SINGLE DRUM ELECTRIC HOIST.

and easily handled by the operator. If desired the lever of the controller can be made of the same design as the brake and clutch levers.

For driving these hoists the manufacturer, the Allis-Chalmers Company, Milwaukee, Wis., furnishes either direct or alternating-current motors wound for the usual voltages, and if alternating current either 25-cycle or 60-cycle machines. Where current is to be taken from an existing plant, its nature is, of course, fixed, and the motors must conform thereto. When a new generating plant is to be installed, however, the question as to whether it is better to use direct or alternating current will depend for its answer largely upon local conditions.

Electrical Equipment for Iron Mines.

The new power plant which Witherbee, Sherman & Co. are erecting on the Lake Champlain shore at Port Henry, N. Y., furnishes an interesting example of the growth of electricity in mining. It is not generally known that the lower Champlain Lake region produces a goodly proportion of the United States annual supply of iron ore. The various shafts of this company alone yield from 500,000 to 600,000 tons of iron ore yearly, while with the new electrical equipment the ultimate output will be 1,000,000 tons.

Owing to the fact that the principal shafts of the mines are scattered over a considerable area, electricity has been found to be the most flexible form of power transmission and is almost universally used. Power for this purpose is generated at present both by water and steam. At Mineville there is a steam plant with a 750-kw, engine-driven generator which supplies current at 3,300 volts for local distribution. This power is supplemented by two small water power plants; a 300-kw water wheel-driven generator unit is located at Wadham's Mills and a 370-kw unit at Kingdom, about eight miles from this point. At Wadham's Mills a Morgan-Smith turbine is used, operating under a 48-ft. head. Power at the Kingdon plant is furnished by a Pelton impulse wheel under a head of 290 ft., water being carried through a 32-in. pipe, a distance of 1⅛ mile from the reservoir. These stations are situated about eleven miles from Mineville and deliver current there at a potential of 6,000 volts. This voltage, made desirable because of the saving in transmission, is stepped down to 3,300 at Mineville and is used in conjunction with the 750-kw, 3,300-volt steam-driven machine to supply power at the various shafts. Induction motors are used for driving hoists, pumps, air compressors, etc., operated at 25 cycles and 440 volts.

The power house which is being built at Port Henry is some six miles from the mines, and will be interconnected with the other sources to supply the increasing demand for power. The station is to be thoroughly modern, being built of monolithic reinforced concrete. Not only the building but the stack will be constructed of this material. "Iron Clad" Portland cement, manufactured by the Glens Falls Portland Cement Company, will be used, mixed with tailings from the mines. Fire-proof construction will be employed throughout and the station is to be a typical example of the use of this building material.

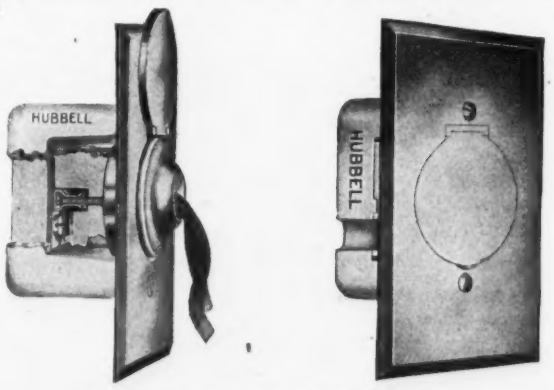
The structure is planned after the Roman style of architecture and is of pleasing design. The main building containing the boilers is 116 ft. by 54 ft., while the turbine generator room measures 39 by 59 ft. and extends at right angles from the center of the main structure. By making use of the Curtis turbine much floor space is saved and the building is very compactly constructed.

Steam will be generated by four 500-hp Babcock & Wilcox boilers, arranged in pairs on either side of a 175-ft. stack, which occupies about the center of the power house. There is space for two more boilers of the same capacity, one at the side of each pair. The boilers are hand-fired, and coal is conveyed to each by a car on a track running the length of the building. This car is filled from an overhead hopper through a hinged chute. The hopper is filled by a vertical bucket conveyor which carries the coal from a pit filled directly from cars outside the building.

The generating equipment comprises an 800-kw Curtis steam turbine generator which will deliver current directly to the line at a potential of 6,600 volts and 25 cycles. The compactness of the vertical unit has permitted a remarkably economical disposition of machinery in the generating room. Space is left for the installation of a second turbine, which will probably be installed at once. The switchboard is located in a gallery with a reinforced concrete floor. On this floor is placed also the motor-driven exciter sets, and space is available for two frequency changer lighting sets. A supplementary exciting unit is provided by a 25-kw horizontal Curtis steam turbine generator. The entire electrical equipment for this power house will be furnished by the General Electric Company.

Flush Receptacle.

The receptacle illustrated herewith possesses the advantageous feature of presenting practically a flush surface when in use and a dust-proof one when not in use. From the sectional view of



FIGS. 1 AND 2.—FLUSH RECEPTACLE.

Fig. 1 it is seen that when the receptacle is in use the cover rests upon the plate while the cap sets in a recess, leaving a surface upon which there is practically no projection. When the receptacle is not in use, as seen from Fig. 2, the surface of the plate is not only absolutely flush, but it is completely dust-proof. This receptacle is manufactured by Harvey Hubbell, Inc., Bridgeport, Conn.

Experimental Electrical Apparatus.

The boy of modern times is no longer satisfied with his toy wagon made out of a soap box, but he must needs have the real thing, so far as his pocketbook or the indulgence of his parents will permit. To enable him to have his railroads and trolley cars, the Carlisle & Finch Co., of Cincinnati, O., is manufacturing a large line of miniature railroad apparatus from which he can choose. The company can furnish anything from a small and inexpensive motor car to an elaborate railroad system with bridges, stations, switches and everything complete to the smallest details. Such an outfit is shown in Fig. 2. The locomotive is of the latest "Atlantic" type and is a perfect model made to exact scale. The cars are made with the same care and exactness. If preferred, freight cars can be substituted for passenger cars and a freight station for the passenger station. This is only one of the very many combinations which may be obtained.

Miniature trolley cars with overhead trolleys, trolley poles and wire are made in several sizes. The one shown in Fig. 1

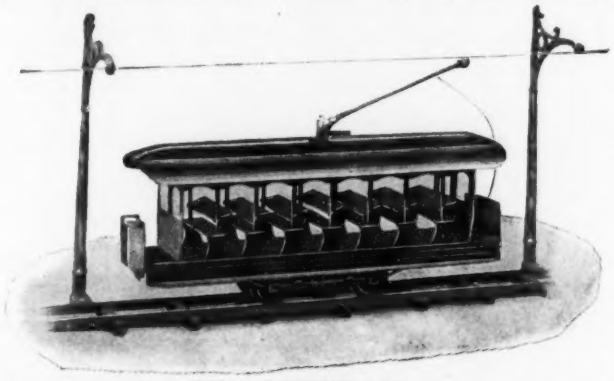


FIG. 1.—TROLLEY CAR.

is no "make believe," but is an accurate working model. The current is conducted to the trolley by means of the overhead wire, thence down the trolley pole to the motor on the car, returning to the battery through the rails of the track. A double-track railway can be constructed and double bracket poles may be purchased for the purpose. Several different styles of trolley cars are manufactured.

Fig. 5 shows a dynamo driven by a water motor. This dynamo will furnish direct current which may be used to run small motors, light miniature incandescent lamps and charge

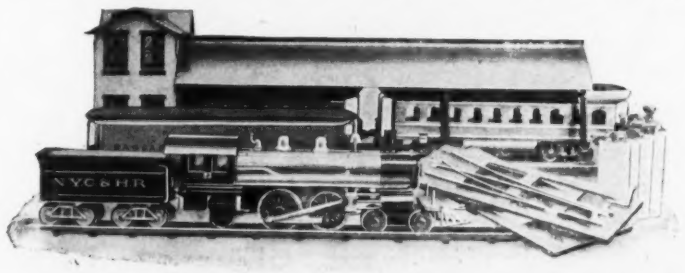


FIG. 2.—ELECTRIC LOCOMOTIVE.

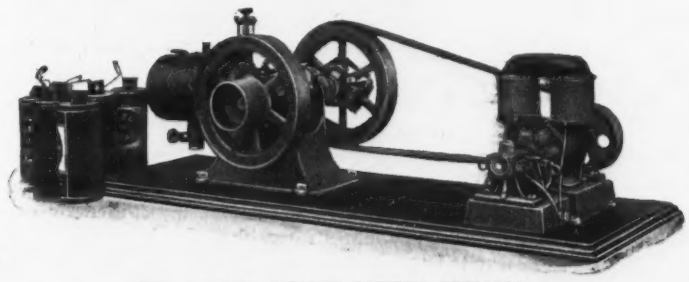


FIG. 3.—GAS ENGINE DRIVING DYNAMO.

storage batteries. On 50 lb. water pressure it will give 15 volts and two to three amperes. The water motor may be attached to any household faucet by means of the hose connections furnished with it. The water is carried off by the waste pipe of the sink or washstand and no extra piping is required. The dynamo is very efficient and is well made. Many thousands of these water-driven dynamos are in use, and they have been found of great service to physicians for charging storage cells.

If more current is wanted the little apparatus shown in Fig. 3 will solve the difficulty. The gas engine is of one-quarter horse-power and drives a dynamo of 75 watt capacity. The engine is a perfect working model. It is water jacketed, has a hit-and-miss governor and operates on the well-known four-cycle principle. The dynamo is usually furnished shunt wound, but may be had with series winding if preferred. Such an outfit is capable of furnishing 20 volts and from four to five amperes. Everything is supplied complete and ready to run, including batteries and spark coil. The engine may be operated by gas or gasoline, and will be arranged for either fuel when so ordered.

The company has brought out a large number of experimental dynamos, which may be purchased in parts and wound and put together by the amateur. One such dynamo is shown in Fig. 4.

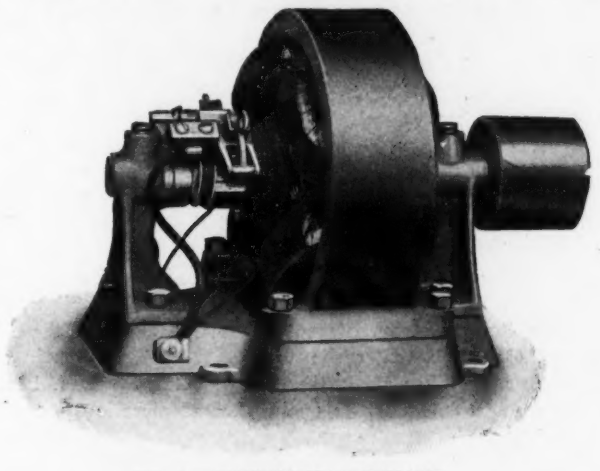


FIG. 4.—EXPERIMENTAL DYNAMO.

This dynamo is of nominally 150 watt capacity, but it is capable of furnishing 250 watts without serious heating. The armature core is made of soft sheet steel punchings and is wound so as to require only two brushes. These brushes are of carbon. The field core is a steel casting. This is an exceptionally well designed dynamo and is a beautiful running piece of machinery. For experimental work of all kinds it will be found of great use. A similar dynamo is made for alternating current. It is the same size as the above but has a special armature. The commutator and collector rings are finished and attached to

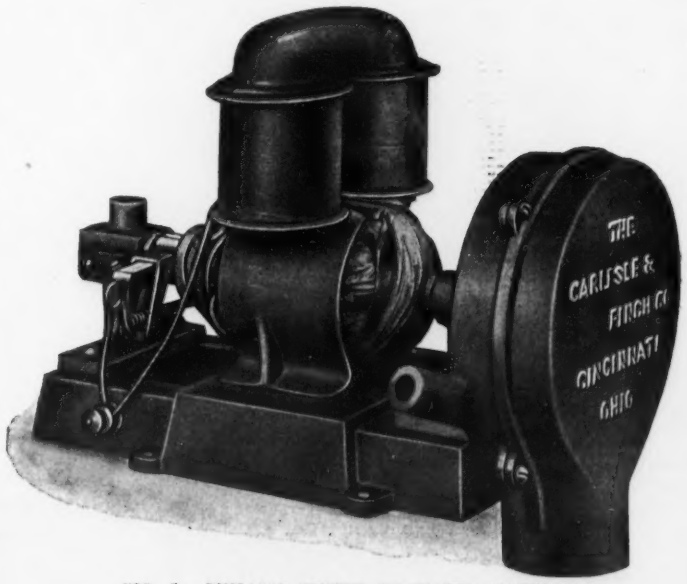


FIG. 5.—DYNAMO DRIVEN BY WATER MOTOR.

the shaft in the correct position. This dynamo is a self-exciting alternator of 50 volts and four to five-ampere output.

All of the apparatus made by this company, with the exception of the miniature railways, may be obtained in parts and assembled by the purchaser when desired.

Equipment for Textile Factory.

The Rhode Island Worsted Company, of Indian Orchard, Mass., is the latest addition to the list of New England worsted mills and cloth printing establishments to install electrical drive. This company's new mill at Stafford Springs, Conn., will be equipped with a 20x36-in. Allis-Chalmers Corliss engine and a 225-kw belt-driven alternator with belted exciter, also a 150-kw belt-driven alternator and exciter of the same make, the latter machine to be driven by means of a water wheel. The complete outfit includes full switchboard equipment and three 50-hp and one 15-hp Allis-Chalmers induction motors used in the weave shed and other parts of the mill.

The cloth printing experts have realized the superiority of electrical drive for the printing machines. Previous to the adoption of this method, the machines were driven by twin tandem engines, direct coupled to the main driving shaft of the machine, the variation in speed being obtained by hand-throttling of the engine. The printing room was invariably a dirty, oily, damp place, and the large amount of condensation in the long steam pipes between boiler room and printing room, created a condition of power extravagance against which the electric motor drive has produced most favorable results in economy. The exhaust steam from the engines has, in some cases, been used for the heating of water, through indirect contact, for use in the dye-houses, but the economy of the electric drive is so great that the live steam used in place of the engine exhaust is not a matter of much consideration.

The eminently successful operation of several installations of multiple voltage systems of motor control made by the Allis-Chalmers Company, under the Ward Leonard patents, in cloth printing and finishing establishments of New England, has developed a wide field for the application of electric motors in a great industry.

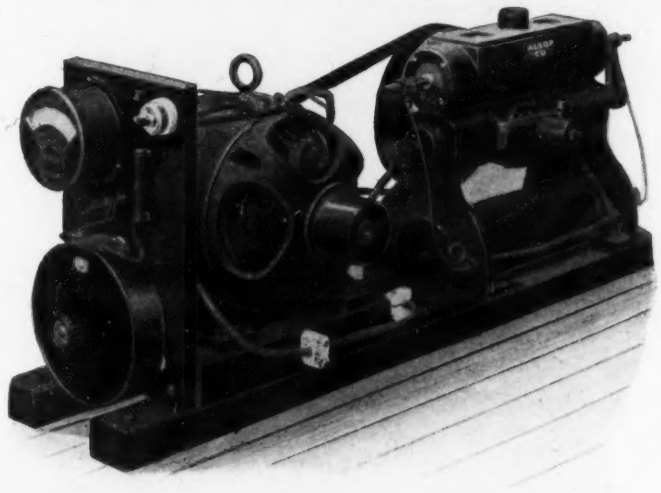
The United States Finishing Company, of Norwich, Conn., Algonquin Printing Company, of Fall River, Mass., the Glenlyon Dye Works, Phillipdale, R. I., and the Arnold Print Works, of North Adams, Mass., have had the multiple-voltage system installed in their several plants, and found the electrical drive eminently superior to the older practice. The advantages of the multiple-voltage system of electric drive for this class of work are found in its cleanliness, economy of power, saving in floor space and the ability to obtain a line of speeds necessary for the varieties of work which may at any time be put upon any printing machine. When using but one color, different speeds may be required according to the character and thickness of the cloth, and the design being printed upon it, these conditions determining the maximum speed permissible with proper setting of color. With a number of colors, which usually means an intricate pattern, different speeds may be required to obtain the proper register as well as the setting of the colors. The printer finds the multiple-voltage system of particular advantage in "making ready," which usually consumes much time in getting the proper register and determining the proper pressure of the rolls to insure good setting of the ink. For this work very slow speeds and quick starting and stopping are a necessity. Once he has all adjustments made and has determined the proper speed for the work in hand, he lets it proceed, noting on the controller the notch at which he desires to run, so that if it is necessary to stop the machine, it can be instantly set to work again at the same speed and without loss of time in finding the proper speed.

The Alsop Process of Ageing Flour.

An electrical process of ageing flour for use by flour mills has been undergoing practical development for several years past and is now in use in a large number of mills both in the United States and foreign countries. The process in brief consists in bringing flour in contact with air, which has been previously treated by the passage through it of a flaming electrical discharge or flash. The Alsop process (the apparatus for which is made by the Alsop Process Company, of St. Louis) for flour mills, is covered by patents granted to James N. Alsop, of Owensboro, Ky., in March, 1903. After considerable experimentation the apparatus has been reduced to a very substantial and simple form.

The apparatus as put up for small flour mills is shown below. It is a complete self-contained unit, consisting of a dynamo, an air pump and a make-and-break device operated by the same movement as the air pump, all mounted on one base. The small unit, illustrated herewith, employs a 500-volt, 1½-kw generator, which can be belted from any line shaft in the mill. From the generator is belted a pump and the reciprocating movement of the pump also operates a make-and-break device for obtaining the flash or arc through which the air is passed. Underneath the pump is a large induction coil, which is connected in series with the 500-volt, shunt-wound dynamo. The flashes are obtained by making and breaking this circuit, the make-and-break device being simply connected in series with the dynamo and induction coil. When the pump reaches one end of its stroke, a temporary closing of the circuit takes place between copper electrodes. The arc is drawn out until it breaks and a contact is made at the other end of the pump stroke, which in turn draws out the arc, and so on, there being one flash for each stroke of the pump. The ionized air, as it is termed by the developers of this process, is forced by the pump through a short length of rubber hose, and then through metal piping to whatever part of the mill it is needed. To bring this ionized air into contact with the finished product of the mill it is passed through reels or agitators through which the flour passes as it comes from the mill.

The sizes of generators employed vary from 1½ to 7½ kw,



APPARATUS FOR AGEING FLOUR.

depending on the amount of flour to be treated and the capacity of the mill. The small unit with 1½-kw dynamo illustrated is sufficient for a mill of 25 to 40 barrels daily capacity. The current in this flaming discharge circuit, as measured by an alternating-current ammeter on this size of machine, is found to be only one ampere, although on looking at the discharge it might reasonably be supposed that the current was of considerably larger volume. It is necessary to employ specially wound dynamos in order to insulate against the high voltage produced by the induction coil.

The result of this treatment of the flour is not only its whitening or bleaching, but is said to accomplish in a few moments the same effects as the ageing of fresh flour by storage, which has been practiced by millers and warehouse men for a long time to better fit the flour for bread, making and giving a higher grade product. The result of ageing is apparently to render the flour more susceptible to the baking ingredients. Flour that has been stored will absorb more water, bake a loaf of larger volume and show an improvement in every way over freshly milled or unseasoned flour. The treatment of freshly milled flour by the Alsop process is stated to accomplish practically the same result as that brought about by ageing. It is therefore supposed that the elements in the atmosphere which change the flour as it is stored in the mill or warehouse are the same as those produced by this flaming discharge of electricity. It is interesting to note at the same time that this ionized air has been found by spectroscopic tests made by Professor Munroe, of Munroe, Hall & Hopkins, Washington, D. C., to be radioactive.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received by the mercantile agencies indicate that in all departments of agriculture and industry business is exceedingly active, surpassing even the phenomenal record of 1905, which, in turn, eclipsed all preceding years. Reports from leading cities indicate that trade was well maintained during the week and further improvement in collections is noted. Holiday goods continue to occupy a position of prominence, but distribution of staples is on a large scale. Leading manufacturing industries are receiving orders for delivery far into next year, the volume of advance business being exceptional for iron and steel products, and a sharp advance in the price of raw cotton indicate increasing consumption by spinners. The really serious cause of complaint is the practically country-wide congestion in railway traffic, which affects grain movement, collections and retail trade in the northwest; delays delivery of badly-needed coal supplies in the entire west; interferes with the movement of cotton to market at the south and hampers manufacturing operations in the iron and steel, textile, lumber and other trades, all of which reflect superabundant prosperity. In the iron and steel industry record activity is noted and foreign iron is coming in freely and being ordered largely for future delivery. Pig iron prices are still moving upward at some points. The significant feature of the week was the purchase by a prominent agricultural implement concern of 20,000 tons of Scotch iron for delivery at New Orleans, the quotation being $21 ex-ship. It is understood that the iron will be used in the manufacture of machinery for export and that therefore the drawback of duty will be demanded later on. Imports of foreign iron are growing. Car congestion retards deliveries of domestic iron from producing plants to consumers. New business in steel rails is of fair proportions. Sales of track material, wire and wire nails and steel bars are heavy, but bar iron is not so active at the advanced quotations. Demand for structural material has improved and plenty of business is in sight. Copper is higher, but little is available for prompt shipment. The closing quotations are 22⅜ for lake; 21⅞ for electrolytic, and 21 11/16 for casting stock. The record of business failures last week was improved, the number as reported by *Bradstreet's* being 174 against 212 in the previous week, and 188 in the corresponding week of last year.

ALLIS-CHALMERS ORDERS.—Messrs. Jones & Naumburg, of New York City, have recently purchased a direct-current generator unit consisting of a 22x36-in. Allis-Chalmers "Reliance" Corliss engine, direct coupled to a 200-kw generator, 240 volts. The new unit will be installed in connection with motor drive, in place of belt drive and shafting, throughout the factory of the purchasers. The Central Electric Company, of Chicago, has contracted with the Allis-Chalmers Company for furnishing a 16x36-in. "Reliance" Corliss engine, direct coupled to a 250-kw alternator with exciter, for the Pullman Company, Pullman, Ill. The alternator is a 2,300-volt, 60-cycle, 3-phase machine. The Peerless Woolen Mills, Rossville, Ga., will install an extensive new engine-generator and induction-motor equipment recently purchased from the Allis-Chalmers Company. The prime mover is a 20x36-in. "Reliance" Corliss engine, bolted to a 250-kw alternator. The induction motors included in the new equipment are as follows: Two 75-hp, 680 r.p.m.; one 140-hp, 850 r.p.m.; two 30-hp, 850 r.p.m.; one 20-hp, 1,130 r.p.m.; one 15-hp, 1,130 r.p.m. A 3-panel switchboard and a 8-kw exciter, complete the outfit. The induction motors are standard Allis-Chalmers construction.

THE ELECTRIC CABLE COMPANY, of 17 Battery Place, New York, has recently sold to Westinghouse, Church, Kerr & Co., a large amount of Voltax cables to be installed on the New York, New Haven & Hartford Railroad Company's plant at Cos Cob, Conn. The new Voltax waterproofing compound in its liquid form is being extensively used on wooden reels. The N. J. Patrick Company, of Derby, Conn., has recently ordered from the Electric Cable Company a considerable amount of this material which is used to prevent the wooden material from absorbing moisture. It is said that the ordinary wooden reel when exposed to the rain absorbs from 6 to 8 pounds of moisture.

FIXTURE STRIKE.—A lockout is on in New York City in the electric and gas fixture manufacturing industry. Over 2,000 men are said to involved already. The lockout was ordered by the employers' organization because the demands made on Edward F. Caldwell & Company were considered unusual and unreasonable, and if they were granted the other members of the Employers' Association were liable to be confronted with similar demands. The strikers demanded that no pay shall be deducted when workmen are late on Saturdays, that the supper hour shall be included in payment for overtime, that an employe who had refused to work overtime under the usual shop conditions and was discharged should be reinstated. The firm sent a reply to the effect that the first two demands were granted before the strike was ordered, and that the last two demands were refused.

PRODUCER PLANT FOR PHONOGRAPH.—The Edison phonograph concern, the National Phonograph Co., of West Orange, N. J., is erecting a plant for producer gas, having a capacity of 60,000 cu. ft. per hour, which will be sufficient to run the wax pots in the shop where the phonograph record cylinders are cast. The company will, it is said, continue for the present to use gas from the Public Service Corporation in the japanning and tool shops and for the running of the forges, but if the new scheme is a success, it will be extended to these departments and in time over the entire allied Edison works and in the new storage-battery department. Mr. Edison has lately been building a number of new reinforced concrete shops at the West Orange laboratory.

NATIONAL ELECTRICAL SALES.—The National Brake & Electrical Company, Milwaukee, Wis., reports among recent orders for generators the following: Simmons Mfg. Co., Kenosha, Wis., one 1,000-kw engine-type alternator; Union Electric Light & Power Co., St. Louis, Mo., two 500-kw, three-unit synchronous motor generator sets and one 200-kw induction motor generator set; Proctor & Gamble (for Staten Island plant), one 400-kw engine-type alternator and one 125-kw engine-type alternator; Hicks Locomotive & Car Works, Chicago, Ill.; one 500-kw belted alternator, Clymer Power Co., Riegelsville, Pa.; one 250-kw water-wheel type alternator; U. S. Light & Traction Co., Hobart, Okla.; one 250-kw engine-type alternator, and one 250-kw engine-type alternator for Sheridan, Wyoming, plant of above company.

ELECTRIC LIGHTING AFFAIRS IN MILWAUKEE.—The Plankington Light & Power Company has been incorporated, and Mr. W. W. Plankington, president of the new company, has applied to the Milwaukee Council for a franchise to lay conduits and string wires in the Fourth Ward. The incorporators are connected with the three principal electric service companies of Milwaukee. Mr. Plankington represents the Plankington estate, and Mr. H. A. J. Upham the Wells estate, each of which owns a plant supplying current to buildings within a radius of several blocks. The third incorporator, Mr. George P. Miller, is attorney for the Milwaukee Electric Railway and Light Company. These connections of the incorporators have given rise to rumors of a combination of the several electrical interests mentioned.

HEAVY RIVER CABLE.—The Worcester works of the American Steel & Wire Company have just completed the heaviest cable ever produced at the works. It is 6,500 ft. in length, 2½ in. outside diameter and weighs about 70,000 lb. Its purpose is to convey electrical energy under the waters of the St. Lawrence River, from the power plant of the Shawinigan Water & Power Company at Shawinigan, midway between Montreal and Quebec, to asbestos mines some distance away and on the other side of the river. The cable is of the three-phase type. It will carry a 25,000-volt current. Each of the three strands is insulated with rubber before being laid up, and a general coat of the same insulation is then given. Jute is afterward laid on, and the whole is covered with heavy armor wire.

CHICAGO SUBWAY TELEPHONE.—The transaction involving the transfer of the telephone department of the Illinois Tunnel Co. to the independent telephone interests of the central west has been closed. As a result the Chicago Subway Company will benefit to the extent of nearly $600,000 in revenues a year without a dollar's outlay. The development of the telephone to cover the whole city of Chicago, and provide for 100,000 telephones, 20,000 of which must be in operation in 1907, and gradually increased at the rate of 10,000 a year thereafter, will begin at once.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market activity was restricted by firm money rates. A strong undertone prevailed, however, but the effect of the Union Pacific report and the expectation of further "rights" on the Hill stocks were minimized by narrow money conditions. Little interest was shown in the speculative market, which was a professional affair, with more or less manipulation in certain leading specialties and in some of the minor issues as well. The loan market was comparatively easy, the call rate keeping within 7½ per cent until Friday, when 27 per cent was quoted with renewals at 8 to 9 per cent. The sale at auction on Wednesday of $4,800,000 of new Manhattan Elevated stock attracted some attention. The prices realized were from 141 to 143. The declaration of the usual 10 per cent annual dividend by the Lackawanna directors, making 20 per cent on the stock for 1906, was seemingly taken as a matter of course by the Street. There were no features among the electrical stocks and no marked changes in any of them, transactions being limited as to the number of shares sold. Western Union made a net advance of 2⅛ points, closing at 87⅝. American Locomotive common closed at 76 and preferred at 111¾. Havana Electric Railway is down 1 point, the last quotation being 46. The curb market during the week was very irregular with most of the trading in the mining group and with manifest liquidation in many of them. The attempt to sell met with poor success. Following are the closing quotations of December 4:

NEW YORK

	Nov. 27	Dec. 4		Nov. 27	Dec. 4
Allis-Chalmers Co.	17⅜	17⅜	General Electric	175⅛	177⅛
Allis-Chalmers Co. pfd.	45	46¾	Hudson River Tel	...	...
American Dist. Tel	25	26	Interborough Rap. Tran.	...	...
American Locomotive	74⅛	75⅛	Mackay Cos.	72¼	72¾
American Locomotive pfd.	111	111	Mackay Cos. pfd.	68⅝	68¾
American Tel. & Cable	88	88	Marconi Tel	...	...
American Tel & Tel.	...	...	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	73	70¾	N. Y. & N. J. Tel.	...	...
Electric Boat	30	32	Western Union Tel.	87⅜	86¼
Electric Boat pfd.	75	72	Westinghouse com.	150	152
Electric Vehicle	12	...	Westinghouse pfd.	...	...
Electric Vehicle pfd	17	...			

BOSTON

	Nov. 27	Dec. 4		Nov. 27	Dec. 4
American Tel & Tel.	136	136½	Mass. Elec. Ry. pfd	69½	70
Cumberland Telephone	117¾	...	Mexican Telephone	4¾	...
Edison Elec. Illum.	228½	225	New England Telephone	129	...
General Electric	178¼	178	Western Tel. & Tel.	9	...
Mass. Elec. Ry.	19	19¼	Western Tel. & Tel. pfd.	80	79½

PHILADELPHIA

	Nov. 27	Dec. 4		Nov.	27	Dec. 4
American Railways	51¼	51¼	Phila. Electric	8⅝		8¾
Elec. Co. of America	11¼	11⅝	Phila. Rapid Trans	21⅛		22⅛
Elec. Storage Battery	70	69	Phila. Traction	97		96¾
Elec. Storage Battery pfd.	...	...				

CHICAGO

	Nov. 27	Dec. 4		Nov. 27	Dec. 4
Chicago City Ry.	160	160	National Carbon	85	85
Chicago Edison	144	...	National Carbon pfd.	*119	115
Chicago Subway	50	50	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	26	27⅛			

HUDSON TUNNEL MERGER.—Action bearing on the consolidation of all the companies building traction tunnels under the Hudson River was taken last week with the filing of articles of consolidation in Trenton by the Hoboken & Manhattan Railroad Company and the Hudson & Manhattan Railway Company, each of which is engaged in the construction of a part of the traction tunnels which are being completed under the Hudson. Both are controlled by the Hudson companies' interests. The merged concerns are incorporated under the name of the Hoboken & Manhattan Company, with a capitalization of $38,500,000. The officers of the new corporation are: President, Alexis P. Bartlett, of New York; vice-president, Edward R. Greene, of Brooklyn; secretary, Ross A. Mackey, of Brooklyn; treasurer, Neil A. Weathers, of New York. The capitalization is $6,400,000 in excess of the former stock of the two companies. Two weeks ago the Hudson & Manhattan increased its stock from $100,000 to $17,100,000 and the Hoboken & Manhattan from $500,000 to $15,000,000.

DIVIDENDS.—The American Graphophone Company has declared the regular quarterly dividend of 1¼ per cent on the common stock, payable December 15. Directors of the Laclede Gas Company have declared the regular quarterly dividend of 1¼ per cent on the common stock and the regular semi-annual dividend of 2½ per cent on the preferred stock. Both dividends are payable December 12. The Niles-Bement-Pond Company has declared a special dividend of 40 per cent, payable January 2, on the common stock. The directors of the Tri-State Telephone Company have declared a fourteenth quarterly dividend at the rate of 6 per cent per annum, payable December 1, 1906, to stockholders of record of November 22, 1906. The company, under its guarantee, will also pay the nineteenth quarterly dividend of the Twin City Telephone Company at the stipulated rate. Directors of the Rochester Railway Company have declared a quarterly dividend of 1 per cent on the common stock, payable December 1.

MANHATTAN RAILWAY STOCK.—The Interborough Rapid Transit Company sold its holdings of 48,000 shares of the stock of the Manhattan Railway Company last week at public auction for a total of $6,776,643. The indebtedness of the Manhattan Elevated lines to the Interborough, to cover which the stock was given into its treasury, was $3,452,183 on September 30, and the sum realized at auction thus leaves a balance of $3,324,460 to the Interborough for future expenditures on behalf of the elevated lines. The stock auctioned was delivered to buyers on December 3, and will be thus available for delivery on the five and six-day contracts. Considering that none of the stock sold as low as the underwriters' price, 140, the sale was regarded as satisfactory. The Interborough Rapid Transit Company will find its charges increased $336,000 per annum as a result of the sale, since dividends of 7 per cent will now have to be paid on this stock, which brings the total amount outstanding up to $60,000,000.

WESTERN UNION BONDS.—The directors of the Western Union Telegraph Company have decided to issue at 87½ $10,000,000 of the $25,000,000 4 per cent bonds recently authorized by the stockholders. Privilege is given to stockholders to subscribe for them in an amount equal to 10 per cent of stock holdings of record December 5 on a basis of $875 for every bond of $1,000 face value. Ten per cent must accompany the subscription and the remainder must be paid before January 15. The subscription privilege is available December 6 and expires at the close of business December 17. The bonds have been underwritten by Kuhn, Loeb & Co. They are convertible into stock at the option of the holder at par between January 2, 1909, and January 2, 1919. At the option of the company they are redeemable at 5 per cent premium and accrued interest on May 1, 1912, or any interest date thereafter. They mature November 1, 1936.

ELECTRIC CO. OF AMERICA.—An official announcement has been made in Philadelphia of the plan of the Electric Bond & Share Company, of New York, to take over the Electric Company of America. The terms provide for an exchange of the present stock of the Electric Company of America into a collateral trust 5 per cent gold bond equivalent to a value of $14 per share, to be secured by a pledge of the securities turned in by the Electric Company of America. The bonds will also be secured in the sum of $1,000,000, which will be paid to a trustee and constitute a fund which can be used only for betterments and extensions to the Electric Company of America properties. The exchange, it is stated, will work out the equivalent to a dividend of 7 per cent of the par value of the present Electric Company of America stock.

SYRACUSE LIGHTING PROPERTIES.—A special meeting of the stockholders of the Syracuse Lighting Company will be held December 6 to decide the proposition of leasing all the property and franchises of the company to the Onondaga Lighting Company which was recently organized. The stockholders will also at the same time vote upon the proposed increase of the common capital stock of the company from $3,000,000 to $8,000,000, to consist of 80,000 shares of the par value of $100 each. If that is done the capital stock will consist of $8,000,000 common and $1,000,000 preferred. It is said that the Onondaga Lighting Company, which is backed by the United Gas Investment Company of Philadelphia, will take a long lease of the Syracuse Lighting Company and guarantee the stockholders a fixed dividend.

HUDSON RIVER POWER EARNINGS.—The Hudson River Electric Company properties reports for September and twelve months ended September 30 as follows:

	1906.	1905.	1904
September gross	$78,730	$69,530	$52,356
Expenses	48,770	34,862	25,836
September net	$29,960	$34,668	$26,520
Twelve months gross	$855,329	$683,681	$497,553
Expenses	474,335	399,701	257,840
Twelve months net	$380,994	$283,980	$239,713

UNPAID LIGHTING BILLS.—It is stated that in Greater New York, owing to the hold-up of all bills ever since the Low administration, there is between $8,000,000 and $9,000,000 due to the lighting companies from the city.

GENERAL NEWS.

Construction News.

BISBEE, ARIZ.—A franchise has been granted to the International Gas & Light Company to erect and maintain an electric light and power system in this place.

BLYTHEVILLE, ARK.—A 50-year franchise has been granted to the Blytheville Electric Light, Water & Street Car Company by the City Council. The company proposes to erect water works, an ice plant and an electric street car line running from this place to Chickasawba.

SACRAMENTO, CAL.—This city has in contemplation the construction of an electric light plant, and Geo. N. Randle, city engineer, has been instructed to investigate the matter.

SAN DIEGO, CAL.—The Common Council has granted a franchise to the South Park & East Side Railway Company, to construct and operate a street railway in this city.

CHICO, CAL.—The Northern Electric Company is contemplating extending its line from Oroville to Palmero and from there to Bangor and Wyandotte. Henry A. Butters is president.

OAKLAND, CAL.—Application has been made to the City Council by the Union Belt Railway for an additional franchise. It is the intention of the company to continue the line around the entire city.

HIGHLANDS, CAL.—The Chamber of Commerce has entered into a contract with the Edison Electric Company for 90 street lamps. Work will commence at once on installing the street lighting system.

PASADENA, CAL.—Owing to litigation and other complications, the City Council has decided to readvertise for additional supplies for proposed municipal electric light plant, for which bids will be opened December 11.

NEVADA CITY, CAL.—The Bay Counties Power Company will shortly start work on a transmission line from the Rome power house to the Alaska mine, a distance of something over ten miles in an air line. The Alaska is now operated by steam power.

PORTERVILLE, CAL.—A. Genslein, manager Porterville Gas & Electric Company, 501 Chamber of Commerce Building, Los Angeles, writes that the proposed plant for Porterville will cost $50,000. J. R. Thompson, Bullard Block, Los Angeles, is the engineer.

LONG BEACH, CAL.—The Pacific Electric Railway Company, of Los Angeles, will make application to the City Council for the sale of a franchise for an electric railway to run through the Willows reclamation district and entering Long Beach on Daisy Avenue.

REDONDO, CAL.—The Pacific Electric & Power Company has applied to the Board of City Trustees for a 50-year franchise to supply electricity for heat, light and power in this city. The company now has in course of construction a large power plant, estimated to cost $1,125,000.

OROVILLE, CAL.—William Durbrow, manager of the Oroville Light & Power Company has submitted a proposition to the Board of Trustees offering to furnish 100 street lamps to the city at the rate of $13.20 for each 32-cp incandescent lamp per year and $96 for each arc lamp.

SANTA ROSA, CAL.—The Pacific Gas & Electric Company has applied to the City Council for a franchise for the purpose of transmitting and distributing electricity for light, heat and power purposes in this city, and bids for said franchise will be received by the City Council until Dec. 18. C. D. Clawson is city clerk.

RED BLUFF, CAL.—J. A. Whitehead, representing the Battle Creek Power Company, states that the power plant will be constructed in the near future. The company has secured a market for the 12,000 horsepower available from the plant. Hunt, Dillman, Meredith and Allen, of San Francisco, are the consulting engineers for the plant.

SAN LUIS OBISPO, CAL.—An effort is being made to have the San Luis Gas & Electric Company establish a day power service in the town. The company agrees to furnish the service providing there is sufficient demand, and arrangements are being made to have some of the large manufacturing plants in the city contract for a power service.

MENDOCINO, CAL.—The Mendocino Electric Light & Power Company has made a contract with the Fort Bragg Electric Light Company by which the latter will begin furnishing the Mendocino company electricity Jan. 1, 1907. The Fort Bragg Electric Company is rebuilding its transmission line to this place and will also extend its line from Noyo to the Jughandle bridge.

SAN FRANCISCO, CAL.—John J. Egan, of 433 Larkin Street, has filed a petition for a franchise to construct and operate a railway along the present Geary Street route, together with another road to run along Fifth Avenue along Point Lobos and Cliff Avenue to the Sutro Baths and Museum. He states that the system will be operated by electricity without the use of overhead trolley wires, or underground wires.

SAN FRANCISCO, CAL.—The Santa Cruz Electric Light & Power Company has filed a certificate with the County Clerk announcing the change of the place of its principal office from Santa Cruz to San Francisco. The Union Traction Company and the Co-operative Electric Company organizations are controlled by the same interests. John Martin is president of all three companies, and Henry Malloch is secretary.

SANTA BARBARA, CAL.—B. F. Pierson, superintendent of the Edison Electric Company, of Los Angeles, states that work will commence on the proposed electric railway from this city to Los Angeles, as soon as the company can secure the necessary rights of way. The Edison Company is also contemplating the construction of an electric railway along the foothills, from the Mission to Montecito, in the near future.

ALAMEDA, CAL.—General Manager E. E. Calvin, of the Southern Pacific Company, announces that plans have been completed to electrify both of the local lines of the Southern Pacific Company and also the line which runs from the Alameda mole and terminates at Fourteenth and Franklin Streets, Oakland. The plans call for the construction of a large power house at Alameda Point. It is also planned to electrify the Encinal Avenue line, from the Alameda mole to High Street, and the Lincoln Avenue line, from the Alameda mole through this city out to Melrose. The cost of the work is estimated at $1,126,695. The next step will be the electrification of the Oakland system, which the officials announce will follow in a short time after the Alameda system has been completed.

TRINIDAD, COL.—The Trinidad Electric Railway Company is contemplating an extension of its line to Reilly.

LONGMONT, COL.—The Northern Colorado Power Company has applied to the City Council of Longmont for an extension of the franchise for an electric light system, which is about to expire, for a period of 25 years. The franchise is the property of the Longmont Electric Light Company. The latter company has been bought out by the Northern company, but the application is made in the name of the original concern.

DENVER, COL.—The Colorado & Southern Railroad Company has signed a contract with the Northern Colorado Power Company for electricity to operate its line between Denver and Boulder, as soon as the power company's plant at Lafayette is completed. The company has decided to use a trolley system, and contracts for the erection of poles and stringing of wire will be let within a few weeks. A. D. Parker is vice-president of the Colorado & Southern Railroad.

MANCHESTER, CONN.—The lighting company, of which Louis Ripley, of Glastonbury, is treasurer, has leased the property of the Manchester Light & Power Company, and is contemplating improvements to the system in Manchester.

HARTFORD, CONN.—Preliminary surveys are being made for the Shore Line Electric Railway Company, which has a franchise to construct and operate an electric railway along the Connecticut shore from Branford to Saybrook and Essex.

MANCHESTER, CONN.—Electricity for the lighting of Manchester will soon be furnished by the Hartford Electric Light Company and already plans are under way for the change, which it is expected will go ino effect January 1. The Hartford Electric Light Company has signed contracts to furnish electricity to the city of Rockville and to Stafford and also to the Consolidated Railway electric railway system between Hartford and Rockville. The Manchester Light & Power Company has leased its system to the Glastonbury Power Company, which is arranging to build a power station in Glastonbury. The Glastonbury company is not yet ready to furnish power and it, too, will find it necessary to purchase energy from the Hartford Electric Light Company. It is understood that the Consolidated Railway Company will not continue to operate its power station here much longer, but will enlarge its plant in Hartford and furnish electricity for operating its lines from the Hartford plant.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until Dec. 17, for furnishing pumps, engine attachments, locomotive headlights, electrical fixtures, etc. Blanks and general information relating to this circular (No. 342) may be obtained at the office of the General Purchasing Officer. D. W. Ross is general purchasing officer.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 18, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va., and Charleston, S. C., a quantity of naval supplies as follows: Schedule 289: Rheostats, night signal set keyboards. Schedule 290: Motors, ammeter testing set, portable testing set, tachometer scale, electrical supplies, ice machine fittings, electrical grinders, etc. Schedule 291: Copper rivets, brass wire, steel wire, air drills, center drills, electric grinders, etc. Schedule 292: Electrical supplies, etc. Applications for proposals should designate the schedule desired by number. E. B. Rogers, Paymaster-General, U. S. N.

AMERICUS, GA.—Joseph M. Roman, of Atlanta, has submitted a proposition to the City Council for lighting the city and pumping the city water by electricity and the installation of a day electric service, and if this is accepted he proposes also to build a street railway system.

ATLANTA, GA.—The Aldermanic Board and the City Council have voted to override the veto of the mayor in which he turned down the granting of the franchise of the Atlanta & Carolina Company to lay tracks for an electric railway on certain streets in the city. The company now has a franchise and will begin at once to lay its tracks. It proposes to build a line from Atlanta to Conyers and also a line from Atlanta to West Point, Ga.

EMMETT, IDAHO.—Mr. Brunston, of Boston, Mass., has appplied for a franchise to operate an electric street railway system in this town for a term of 50 years.

ELGIN, ILL.—The officials of the Merchant Lighting Company have agreed to accept the franchise recently granted by the City Council and are ready to furnish the $12,000 bonds required by the city.

SOUTH BEND, IND.—The Northern Indiana Railway Company has ordered plans for the construction of a power house in South Bend.

HARTFORD CITY, IND.—An effort is being made to organize another electric light company in this city to compete with the one now in the field.

RICHMOND, IND.—M. H. Penee has ordered plans and estimates made with a view of establishing an electric lighting plant in the canning factory in New Paris, six miles east of this city.

NEW ALBANY, IND.—The Louisville, New Albany & Corydon Railway Company will soon ask for bids for the construction of 16 miles of road between New Albany and Corydon. The company is also in the market for electric equipment to electrify the entire system. McKinley Boyle is president.

FT. WAYNE, IND.—The Ft. Wayne & Wabash Valley Traction Company is rebuilding its present high tension line between Logansport and Ft. Wayne, to take the increased voltage from the power house in Ft. Wayne. The power houses, which are located at Boyd Park, Huntington, Fort Wayne and Lafayette, will be discontinued. The sub-stations are being rebuilt, enlarged and newly equipped.

DAVENPORT, IA.—Herbert Wadsworth, of Chicago, Ill., is seeking an electric and gas franchise here.

CHARLES CITY, IA.—The Western Electric Telephone System will expend about $6,000 improving its system in this place.

ATOKA, I. T.—The Atoka light and power plant has been purchased by the new company that was recently given a franchise by the City Council.

OSKALOOSA, IA.—The Oskaloosa Traction & Light Company has been sold to the Oskaloosa & Buxton Electric Railway Company, which is building an interurban line between Oskaloosa and the Buxton coal fields, for $95,000. The Oskaloosa Traction & Light Company owns the electric light and street railway system of Oskaloosa and a hot water heating plant. The new directors of the company are: W. H. Kalbach, W. R. Lacey, Wesley Garner, C. E. Lofland, W. I. Neagle, W. W. Williams, George Kalbach, Frank B. Shafer, Sam Baldauf, all of Oskaloosa. The new officers are W. H. Kalbach, president; W. R. Lacey, vice-president; Wesley Garner, secretary and treasurer.

NICKERSON, KAN.—C. W. Quay, of Hutchinson, will probably ask for a franchise for an electric light plant. C. A. Murphy is city clerk.

HUMBOLDT, KAN.—M. W. Miller, representing the South Western Traction Company, has applied for a franchise to operate and construct an electric light plant.

HUTCHINSON, KAN.—The stockholders of the Interurban & People's Water, Light & Power Compaany have accepted the franchise granted by the City Council and will expend $47,000 in improvements.

DONALDSONVILLE, LA.—The Town Council has granted a franchise to P. Sefton Schneidau to construct and operate an electric street railway in the town for a term of 25 years.

BATON ROUGE, LA.—Mr. Gottlieb, of Baton Rouge, is interested in a company which has purchased the Baton Rouge Electric Light & Street Railway system. It is stated that a new company is to formed with a capital of $1,000,000 and will immediately begin construction work of rebuilding the electric light and gas plants and the laying of new tracks.

HANCOCK, MD.—Lloyd Lowndes, of Cumberland; Henry P. Bridges, of Baltimore; Stuart S. Janney, of Baltimore, and others, are interested in a company about to be organized, to construct an electric plant on Dam 6 of the Cumberland River. The electricity will be transmitted to Hancock, Md., Berkley Springs, W. Va., and other cities and towns.

BALTIMORE, MD.—It is reported that R. B. Fentress, president of the Norfolk Cold Storage & Ice Company and the Baltimore Refrigerating Company, has secured the controlling interest in the Baltimore Electric Light & Power Company and is planning for extensive additions to the plant. The company has recently let a contract for additional buildings and mechanical equipment for the handling of coal. The ice plant and refrigerating machinery will be enlarged. The electric lighting business is being rapidly developed and the company will soon install additional units to be operated in connection with its heating system. The new boilers recently installed are capable of developing 6,000 hp.

PORTLAND, ME.—Work has commenced on an electric plant at Bonny Eagle on the Saco River which is to supply light and power to the city of Portland and will compete with the combination of the two lighting companies of Portland. The parties interested in the company are the stockholders of the Publishers' Paper Company, which is at the present time operating plants at Steep Falls, Bar Mills and Portsmouth, N. H.

DRACUT, MASS.—The town has contracted with the Lowell Electric Light Corporation to furnish 100 incandescent lamps of 30 cp for lighting at $23.25 per lamp per year.

HOPKINTON, MASS.—The Board of Selectmen has signed a 10-year contract with the Edison Electric Illuminating Company, of Boston, for lighting the streets of this town by electricity.

AMHERST, MASS.—The Amherst Gas Company will furnish the Sunderland Electric Light Company with electric power to operate its plant in Sunderland and its sytem in South Deerfield, where the Sunderland company will extend its lines.

PITTSFIELD, MASS.—The Gas and Electric Light Commissioners have authorized the Pittsfield Electric Company to issue bonds to the amount of $50,000, and stock to the amount of $75,000, at 135, the proceeds to be applied to the payment of debt incurred for the Silver Lake station and for other improvements and additions to the plant.

WAYLAND, MICH.—The City Council has granted a franchise to S. Phelps, of Chicago, to establish and conduct an electric light plant in this place.

COLDWATER, MICH.—The Southern Michigan Telephone Company will expend about $85,000 in rebuilding and equipping its exchange in this city.

DETROIT, MICH.—The Detroit Trust Company has been appointed receiver for the Detroit, Flint & Saginaw Railway. It is the intention of the receiver to complete the line to Flint, a distance of 20 miles.

KALAMAZOO, MICH.—W. H. Patterson, promoter, and one of the directors of the Grand Rapids & Kalamazoo Valley Electric Railroad Company, announces that bonds have been sold for the building of the road connecting this city with Grand Rapids. The contract has also been let for the construction of the road. The cost of the road is estimated at $1,000,000.

PEQUOT, MINN.—The question of constructing water works and an electric light plant is under consideration here.

MINNEAPOLIS, MINN.—Surveys are being made by the Minneapolis & St. Paul Suburban Railway Company for an extension of the Robbinsdale line to Anoka.

MANKATO, MINN.—The promoters of the proposed Minneapolis & Dubuque electric railway have made a proposition to build an extension to this city from Faribault.

MINNEAPOLIS, MINN.—Extensive improvements and extensions are contemplated by the Northwestern Telephone Exchange Company for the coming year which will involve an expenditure of $2,500,000, of which $1,000,000 will be spent in the twin cities. W. A. Stanton is district manager.

FERGUS FALLS, MINN.—The City Council has authorized the electric light commission to have plans prepared for the construction of a new dam to furnish power for the city electric light plant. As soon as the dam is constructed the rate for electric lights in Fergus Falls will be reduced from 10 cents to 5 cents per kw-hour.

McCOMB CITY, MISS.—The McComb City Progressive Union is interested in the promotion of a street railway system to connect this city with Summit, Magnolia and intermediate points. A committee has been formed, consisting of Judge J. H. Price, Lucius E. Schilling, of Magnolia; C. V. Ratcliff, of Summit, and Judge J. B. Webb and Fred Muller, of McComb City, to look into the matter.

VERSAILLES, MO.—The telephone system owned by John Brokmeyer has been sold to Dresie Brothers, of St. Louis. The price paid for the plant was $12,500.

ST. JOSEPH, MO.—The St. Joseph & Grand Island Railway is preparing to operate an interurban electric line from St. Joseph to Highland, Kan., a distance of 29 miles.

ST. LOUIS, MO.—Plans have been completed for the construction of a new exchange building for the Bell Telephone Company at St. Louis Avenue and King's Highway, to cost about $60,000.

ST. LOUIS, MO.—President Andrew J. O'Reilly, of the Board of Public Improvements, will employ an expert to go over the figures prepared by Supervisor of City Lighting Carter, who estimates that the city could get its lighting for $512,980 with a municipal plant. Last year under contract the lighting cost $548,939.25.

SPRINGFIELD, MO.—Plans are being perfected for the construction of the new electric railway from Springfield to Nevada. The road will be built for both freight and passenger traffic, and will be 95 miles long. The power house will be located on the Sac River, 37 miles northwest of this city. T. P. McDonough, W. B. Forsyth and T. C. McFann, of Chicago, are interested in the enterprise.

NEVADA, MO.—The appointment of a receiver has been asked for the Missouri Water, Light & Traction Company; also to have set aside a transfer made by the company to the Union Water, Light & Traction Company, of Illinois. The basis of the suit is a fight upon the bonds to the amount of $100,000 in favor of the Lincoln Trust Company and another issue in favor of the Missouri Trust Company, both of St. Louis.

JOLIET, MONT.—A movement is on foot to establish a power plant on Rock River and develop electricity.

KENDALL, MONT.—The owners of the Barnes-King mining property are contemplating the erection of a power plant on Spring Creek, and the construction of an electric railway to Lewiston. The cost of the railway is estimated at $250,000.

WAUNETA, NEB.—An electric light plant will be installed here. Plans are now being prepared.

FAIRVIEW, NEV.—It is stated that a corporation has been formed to build an electric light plant and street railway system in this place. The names of those interested cannot be ascertained.

RENO, NEV.—Senators Francis G. Newlands and George S. Nixon have purchased the Nevada Transit Company's line from Reno to Sparks, a distance of three miles.

CAMDEN, N J.—The City Council has adopted a resolution authorizing Mayor Ellis, City Engineer L. E. Farnham and members of Council, to procure data on the subject of establishing a municipal electric light plant, and report on the same at the January meeting.

ALBION, N. Y.—A new engine of 100 hp is being installed in the Albion electric light and power plant. H. Rice is owner.

ALBANY, N. Y.—The Forest Park Railway Company is contemplating extending its line to the Forest Park Cemetery.

FAIRPORT, N. Y.—The citizens on Nov. 23 voted in favor of issuing $5,000 in bonds to enlarge the electric light plant. A new pump and engine will be purchased.

JAMESTOWN, N. Y.—The Jamestown, Chautauqua & Lake Erie Railway, a steam road, has been acquired by the Sheehan-Mayer syndicate, and will be electrified.

CANASTOTA, N. Y.—The Central New York Power Company has secured a franchise, also the contract for lighting the village streets for five years, and will at once install a plant to be ready for operation by February, 1907. William E. Lewis, of Utica, is president.

ALBANY, N. Y.—The Rev. John S. Ladd, pastor of the Valley Methodist Church, has applied to the State Railroad Commission for permission to construct an electric railway from Peekskill through Van Courtlandtville and Varian's Mills to the village of Oregon, a distance of 3¼ miles.

SAG HARBOR, N. Y.—A new 30-kw generator has been installed in the plant of the Sag Harbor Electric Light & Power Company. The company has recently extended its wires to the North Haven cottage colony and is furnishing about 1,000 16-cp. lamps. George Kiernan is owner and manager.

ILION, N. Y.—A committee, consisting of V. G. Baker, Oswald Sneider, Frank Bach, J. A. Giblin, Herman Kananbel and E. H. Berry, has been appointed by Village President Rix to act with the Electric Light Commission in regard to the question of the purchase of electricity or the continuance of the municipal electric lighting plant.

LITTLE FALLS, N. Y.—I. N. Lovenheim, owner and manager of the Consumers' Electric Light Company, announces the discontinuance of business after Dec. 1. The lighting contracts now in force will be taken over by the Herkimer County Light & Power Company. The plant, poles, wires and fixtures will probably be offered for sale by Mr. Lovenheim.

BERGEN, N. Y.—The Village Board has entered into a contract with the Genesee County Electric Light, Power & Gas Company to light the streets of the village for a term of five years at the rate of $750 a year and to supply electric power to the pumping station of the village waterworks for a term of ten years at the rate of $500 a year. The company guarantees the delivery of Niagara Falls power in the village within one year, unless such delivery shall be unavoidably delayed by litigation.

OSWEGO, N. Y.—The Citizens' Lighting Company has leased the brewery building in East First Street from P. H. Doyle and will use it for a temporary power station until the power house on the old Skenandoah mill site is ready for occupancy. The Citizens' company has secured contracts from local merchants for two or three thousand lamps to be furnished immediately after the first of January if not before. The company has also made a contract for the use of Niagara power for power purposes. The machinery for the plant has been ordered and is expected soon, when it will be placed in position in the temporary power house in East First Street. Work on the pole line and the stringing of wire will begin at once.

HENDERSONVILLE, N. C.—The Hendersonville Light & Power Company is developing another water power situated about a half-mile below the present generating station. The new station will develop 400 hp under a head of 50 feet. Electricity is transmitted to the Hendersonville substation 7½ miles distant at 6,000 volts and stepped down to 2,200 volts. The sub-station is equipped with a 250-hp emergency steam plant. R. M. Oates is manager.

BRYAN, OHIO.—The Council is considering the issuing of $30,000 bonds for improving the water and light plants.

RAVENNA, OHIO.—The Cleveland, Alliance & Mahoning Valley Railroad Company will erect a power house in this place.

SALEM, OHIO.—The Council has granted a franchise to the Youngstown & Ohio River Railway & Light Company, to furnish electric light and power in Salem.

TOLEDO, OHIO.—The Toledo & Indiana Railway Company has completed preliminary surveys for its proposed extension from Bryan to Waterloo, and for a branch line from Delta to Defiance via Napoleon.

MAUMEE, OHIO.—Charles N. Jackson has made application to the City Council for an electric light franchise with the object of using the old abandoned power house of the Toledo & Maumee Valley road at Miami.

CLEVELAND, OHIO.—The Century Telephone Construction Company, of Buffalo, has purchased the telephone manufacturing business of the Williams Abbott Electric Company of this city, and will move the plant to Buffalo.

CLEVELAND, OHIO.—Bids will be received by the Board of Public Service until Dec. 15, for arc lamps, transformers and accessories needed for the extension of the Cleveland municipal lighting plant. A. R. Callow is secretary.

SPRINGFIELD, OHIO.—The Springfield, Wilmington & Cincinnati Railway Company has been chartered with a capital stock of $3,000,000 for the purpose of constructing an electric railway connecting Springfield with Cincinnati. The incorporators are George F. Parmelee, Frederick Gargenhire, Gustav Von Den Steinen and others.

TOLEDO, OHIO.—The city will use at least 1,482 new magnetite arc lamps under the new public lighting contract with the Toledo Railway & Light Company. The Council Committee on gas and light has decided to install 1,375 arc lamps on the streets and about 100 on the bridges, police station and markets. Heretofore the city has been furnished lamps on the bridges free, but under the new contract it will have to pay for them.

HENNESSY, OKLA.—The Hennessy Electric Light & Power Company has been granted a franchise in this place.

SHAWNEE, OKLA.—The City Council has granted a franchise to the Shawnee Gas Company to construct and operate an electric lighting and power plant in this city for a term of 21 years.

ALTOONA, PA.—W. J. Hamor, city clerk, writes that bids will be received on December 12, for lighting the city by electricity for a 1, 3 or 5 year term. C. D. Downs is city electrician.

MEADVILLE, PA.—The City Council on November 21 adopted the ordinance providing for an appropriation of $500 to the Water and Light Committee for the employment of a consulting engineer to advise in the matter of new electric light station and plant.

CLEARFIELD, PA.—The Central Pennsylvania Light & Power Company is making every effort to make temporary arrangements to furnish electricity for lighting the streets and commercial lighting while it is rebuilding its plant which was recently wrecked by an explosion.

CONNELLSVILLE, PA.—The West Penn Electric Company has closed contracts for furnishing electricity for operating several plants in this vicinity. The Fayette Lumber Company has replaced its gas engine with electric power. The Guller Sand Company and the National Foundry & Machine Company, of New Haven, will also use electricity for operating their plants.

MT. HOLLY SPRINGS, PA.—The Borough Council, on Nov. 26, awarded the contract for lighting the borough by electricity to the Mt. Holly Light, Heat & Power Company, which was recently chartered, of which T. M. Nelson, of Chambersburg, is president. The contract price is $850 per year and the town is to have nineteen arc lamps and six 32-cp incandenscent lamps.

NANTICOKE, PA.—Bids will be received until December 11 by the Town Council, for lighting the streets and alleys for a period of 3, 5 or 10 years from the expiration of the present contract, viz., May 1, 1907, with 75 or more electric arc lamps and 30 or more electric incandescent lamps, or with gas or any other approved system of street lighting. C. L. Fairchild is borough secretary.

YORK, PA.—The York County Traction Company is contemplating the construction of 125 miles of railway during the next few years, and work upon four or five lines will begin this winter or next spring. Application for a charter will soon be made to construct a line to Spring Grove, and work will commence on the line as soon as the charter is granted. W. F. Bay Stewart is president of the company.

MIDDLEBURG, PA.—The dam of the Middle Creek Power Company has been completed. The plant, when completed, will have a capacity of 400 hp and will furnish electricity for operating the electric railways and other industries in Sunbury, Northumberland and Selinsgrove. The power plant will be equipped with turbines of 400 hp, a 250-kw, 2,200-volt, alternating-current generator, and 25-kw exciter of 125 volts. The company also has a steam plant at Northumberland.

UNIONTOWN, PA.—The West Penn Railways Company is making a number of extensions to its lines from Uniontown. Electric railway service to Masontown is promised by February 1, 1907. A line is to be built to Brownsville from Footedale, a distance of 9½ miles. The contract for the work in Brownsville borough has been let to John Duggan, of New Haven. The contract will soon be let for the portion of the line from Footedale to Orient, a distance of about three miles.

HARRISBURG, PA.—Plans are being made by the Pennsylvania Railroad Company for a large electric power plant on the middle division, a short distance east of Iroquois, which is about twenty-one miles from Harrisburg. The company also contemplates the erection of similar plants along the middle division for obtaining both water and electricity. Near Iroquois the company has obtained a large tract of land, and a dam will be built across the Susquehanna River. This plant, it is said, is to furnish electricity to supply all the telegraph and signal towers and to run cars between Aqueduct and Mifflin. Other plants will be built near Duncannon and the Rockville Falls. Dams will also be constructed where necessary between Harrisburg and Altoona.

BEAUFORT, S. C.—R. A. Long, owner of the electric lighting plant in this place, has given notice that after Nov. 30 the electric lighting service will be discontinued.

CHARLESTON, S. C.—The Charleston & Summerville Electric Railway Company has placed contracts for the equipment of a complete power plant and line material, and also rails for the entire line from Charleston to Summerville. The generators are to be furnished by the General Electric Company and the gas engines and gas producers by the Snow Steam Pump Company, of Buffalo, N. Y.

WESSINGTON SPRINGS, S. D.—A. F. Pinard, of Wessington Springs, writes that the proposed electric light plant will cost $7,000.

SIOUX FALLS, S. D.—The City Council has granted a franchise to Frank M. Mills to operate an electric street railway service in this city for a term of 20 years.

WAGNER, S. D.—A company is being formed to build an electric railway between Wagner and Lake Andes. Messrs. Grimes and Fisher, of Wagner, are the principal promoters.

PIERRE, S. D.—The city has raised the required funds for the construction of a municipal electric light plant and the contract for the installation of the plant will be let in a short time.

MEMPHIS, TENN.—The city is contemplating substituting for the gas and gasoline lamps in the suburbs 250 electric arc lamps. The city now pays $85 per year for each arc lamp; the Consolidated Gas & Electric Company has agreed to make a rate of $75 per year if 250 new lamps are ordered. The mayor has been authorized to make a contract with the company, if there are no legal obstacles in the way.

COOPER, TEX.—The electric light plant owned by J. W. Hockady has been destroyed by fire.

TEMPLE, TEX.—The City Council is considering the question of establishing a municipal electric light plant.

DALLAS, TEX.—The Dallas Consolidated Electric Street Railway Company contemplates extending its line to Oakland cemetery.

MERKEL, TEX.—The Merkel Light & Power Company has purchased the electric plant at Oak Cliff and will remove it to this place.

PALESTINE, TEX.—The Palestine Telephone Company has been granted a franchise to construct and operate a telephone system in this city.

ABILENE, TEX.—The Roberts Telephone & Electric Company has ordered the material for the erection of a 40-mile toll-line circuit of No. 12 iron wire, between Abilene and Stanford.

HUBBARD CITY, TEX.—W. A. Bass, president of the Union Central Light & Ice Company, of Hubbard City, informs us that it has bought out the Hubbard City Light & Power Company's plant, and will at once proceed to overhaul, rebuild and improve the system and service, for use until the completion of the new modern and up-to-date plant.

WINCHESTER, VA.—The Winchester & Washington City Railway Company has secured the right of way between this city and Berryvale for its proposed electric railway.

NORFOLK, VA.—Permission has been grainted to the Norfolk & Portsmouth Traction Company for the erection of boilers in the new power house, at the foot of Reeves Avenue.

NORFOLK, VA.—The Southern Bell Telephone Company is contemplating enlarging its plant here, and is preparing to extend its lines to the Jamestown Exposition grounds and to Virginia Beach.

COLFAX, WASH.—The Washington Water Power Company is extending its lines to Colfax and will soon furnish electricity to operate the local plant.

BREWSTER, WASH.—R. R. Tyler, of this place, is promoting a company to construct a street car line across the Columbia River at Petros. It is estimated that the line will cost about $10,000.

VANCOUVER, WASH.—The City Council has granted a franchise to Walter H. Moore, of Portland, Ore., and Lester B. French for the construction of an electric street railway system in this city. The franchise is for a term of 50 years.

TACOMA, WASH.—The power plant of the Tacoma Railway & Power Company at Electron has been damaged by the heavy floods, and has been put out of commission. Part of the flume was carried away and the transmission line has broken down. The company has had to depend entirely on its steam plant to operate its system.

MARINETTA, WIS.—A water power company, with a capital of $600,000, will soon be organized in Oshkosh, to develop the High Falls and Johnson Falls on the Peshtigo River. The following men will form the company: E. O. Joslin, E. F. Joslin, Frank Joslin, C. A. Hartley and J. A. Powers, of Oshkosh, and Frank Green, of Chicago. The power will be transmitted to Marinette, Menominee, Green Bay, and probably Oshkosh. Actual construction work will be started in the spring and the power plant and auxiliaries will be completed before the year is over. The estimated cost of the work is over $1,000,000. Over 6,000 horsepower will be developed.

LANGHAM, CAN.—The Board of Trade has decided to install an electric lighting plant.

McLEOD, CAN.—The Council has decided to install an electric light plant during the present winter.

CALGARY, CAN.—The Council will install an electric light plant here at a cost of $100,000. Address Alderman Jones.

STRATHCONA, CAN.—The ratepayers have passed a by-law authorizing the expenditure of $35,000 on a municipal electric lighting plant. Address Mayor Davidson.

BIRTLE, MAN.—The town has decided to go in for an extensive power scheme to supply light and power to this town. Address E. J. Wilson.

WINNIPEG, MAN.—The city has accepted the tender of Babcock & Wilcox Company, Ltd., for two 250-hp water tube boilers complete at $14,750. F. Cambridge is city electrician.

PETERBORO, ONT.—The Peterboro Light & Power Company has offered its plant to the city free of all encumbrances for $250,000.

TORONTO, ONT.—The Electrical Development Company is now furnishing electricity from its plant at Niagara Falls to the Toronto Railway Company and the Toronto Electric Light Company.

New Industrial Companies.

THE MOHAWK ELECTRICAL SUPPLY COMPANY, of Utica, N. Y., has been incorporated with a capital stock of $25,000, by George A. Redman, J. Frank Morse and Eleanor M. Morse.

THE INTERNATIONAL INSTITUTE OF ELECTRO-THERAPEUTICS, of New York, N. Y., has been incorporated with a capital stock of $25,000, by Florence S. Goldberg, Freda Garifolos and Emil Wilder.

THE R. B. COREY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing and dealing in electrical apparatus and supplies. The directors are R. B. Corey, H. C. Adams, Jr., and F. Pfeiffer.

New Incorporations.

SAN DIEGO, CAL.—The Pacific Coast Development & Security Company has been incorporated, with a capital of $1,000,000, by John Campbell, Arthur Small and Frank Turnbull, for the purpose of developing power for lighting, etc.

NAPA, CAL.—Articles of incorporation have been filed for the Napa & Northern Railroad for the purpose of building an electric railway from Woodland to San Francisco, via Napa Junction and Vallejo. The road is to be 70 miles in length.

OAKLAND, CAL.—The Crescent City Railway Company has been incorporated to operate an electric railway from Crescent City, the town site of the Southern California Cement Company's plant, to the works, which are three and a half miles from Riverside, on the Jurupa Rancho, a distance of ten miles. The incorporators are Cecil T. Walker, George W. Reed, P. C. Black, Clarence Reed and B. H. Griffins. The enterprise is financed by William G. Henshaw.

CHICAGO, ILL.—The International Light Company has filed a certificate of incorporation in Dover, Del. The capital stock is $150,000.

NEW ATHENS, ILL.—Articles of incorporation have been filed for the Eastern Farmers' Telephone Company, with a capital stock of $400, by Henry Kaiser, George Irwin and R. Q. Hunt.

BUENA VISTA, ILL.—The Valley Telephone Company has filed articles of incorporation with a capital stock of $1,000. The incorporators are D. F. Gates, L. E. Wentworth, H. H. Rood and J. W. Boursler.

RANTOUL, ILL.—Articles of incorporation have been filed with the Secretary of State for the Coon Brothers Telephone Company, with a capital of $60,000, by James S. Coon, Edmund G. Coon and Ross O. Coon.

MASON CITY, ILL.—Articles of incorporation have been filed with the Secretary of State for the Mason City Telephone & Telegraph Company, with a capital stock of $2,500. The incorporators are W. A. Grundy, J. F. Culp and H. F. Reason.

PEORIA, ILL.—Articles of incorporation have been filed for the Peoria Railway & Terminal Company with the Secretary of State by T. A. Grier, William Jack, Theodore Miller, Frederick H. Smith, of Peoria, and William J. Conzelman, of Pekin. The company proposes to take over the Peoria & Pekin Terminal Company. The capital stock is $1,000,000.

MACON, GA.—The Macon, Americus & Albany Electric Railway has been organized by the stockholders of the Macon & Albany Securities Company. The company has been formed to construct electric railways from Macon to Americus, Albany, Griffin and Atlanta, reducing the mileage between Macon and Atlanta to 86 miles and from Macon to Albany to 90 miles. Nicholas J. Cruger, of Albany, is president.

CHALMERS, IND.—Articles of incorporation have been filed for the Chalmers Telephone Company, with a capital stock of $10,000, by J. C. Chamberlain and others.

WESTLAND, IND—The Westland Telephone Company has filed articles of incorporation, with a capital stock of $260. The directors are J. F. Coffin and others.

CORYDON, IND.—The Harrison County Farmers' Telephone Company has filed articles of incorporation with a capital stock of $5,000. The directors are T. J. Stevens and others.

CRANDALL, IND.—The Harrison County Telephone Company has filed articles of incorporation with the Secretary of State. The company is in the market for material and equipment for the construction of a modern telephone system in Crandall.

DAYTON, IA.—Articles of incorporation have been filed for the Dayton Mutual Telephone Company, with a capital stock of $2,500. The directors are E. M. Lundien and others.

WATERLOO, IA.—The Empire State Construction Company has filed articles of incorporation, with a capital stock of $250,000. The company is authorized to construct, equip and operate railroads by steam or electricity; also to equip and operate telephone and telegraph lines in connection with any railways. The company is to build the Iowa & Northwestern Railroad between Watertown and Stanwood.

SHELBY, KY.—The Shelby County Telephone Company has been incorporated with a capital of $120,000, by W. J. and B. A. Thomas, and associates.

SCOTTSVILLE, KY.—The Scottsville & Liberty Telephone Company has been chartered with a capital of $160, by E. H. Reynolds, of Scottsville, and others.

BARBOURVILLE, KY.—The Barbourville Water, Power & Light Company has been organized by S. H. Hale, of the Barbourville Electric Light Company, and associates. The purpose of the new company is to take over the plant of the old light company and install a water works system.

AUGUSTA, ME.—Articles of incorporation have been filed for the Canaan Power Company with a capital stock of $50,000 by Stephen A. Nye, Frank B. Purinton, of Fairfield, and George S. Ricker, of Clinton.

AUGUSTA, ME.—The Marquette County Gas & Electric Company has been organized with a capital stock of $750,000. The officers are E. J. Pike, of Augusta, president, and Fred Bogue, of Augusta, treasurer.

PORTLAND, ME.—Articles of incorporation have been filed for the Alabama Interstate Power Company, with a capital stock of $3,000,000. The officers are: James E. Manter, president, and Clarence E. Eaton, treasurer, of Portland.

AUGUSTA, ME.—Articles of incorporation have been filed for the United Wireless Telegraph Company, being a merger of the Marconi and American De Forest systems. The new concern will have a capital of $20,000,000. The officers are Abraham White, president; E. F. Buchanan, vice-president; George C. Knabe, treasurer, and Arthur English, secretary, all of New York, N. Y. This merger was referred to in our last issue.

CENTREVILLE, MD.—The Centreville Electric Light & Power Company has been incorporated by W. J. Pearl, Mahlon Foster, W. T. Wright, J. T. Rolph and P. R. Foreman.

STOCKBRIDGE, MASS.—The Stockbridge Lighting Company has been organized with Allen T. Treadway, president; Charles E. Hull, treasurer, and Edward T. Hull, clerk. These officers, with Daniel B. Fenn and Alexander Sedgwick, constitute the board of directors. The company has a capital stock of $25,000. The system will be installed early in the spring, so as to be in operation by the first of May. The source of electric supply has not yet been determined.

GRAND RAPIDS, MICH.—The Ludington Southern Railway Company has been incorporated with a capital stock of $640,000 for the purpose of building a railroad line from Grand Rapids to Ludington, a distance of about 80 miles. Electric power may be used. The directors of the company are: Norman W. Gifford, Chicago, Ill.; David H. Patterson and Samuel H. Kelly, of Benton Harbor; Thomas J. David, Fremont, and Gardner T. Sands, Pentwater.

RICH HILL, MO.—The Hickory Hill Telephone Company has been incorporated with a capital of $500 by Grant Stine and others.

KANSAS CITY, MO.—The Paola & Ossawatomie Light & Fuel Company has been incorporated with a capital stock of $500,000 by Wilson Overall and others.

KANSAS CITY, MO.—The Kansas City & Northern Traction Company has been incorporated with a capital of $200,000 by John H. Atwood, G. F. Jones, W. W. Hooper and others.

JOPLIN, MO.—The Joplin Light, Power & Water Company has been incorporated with a capital stock of $25,000 by James Campbell, of St. Louis, and W. F. Reed, John P. Newell, H. R. Conklin and A. A. Johns.

WAYNESVILLE, MO.—Application has been made to the Secretary of State for a certificate of incorporation by the Oark Transit Company. The company has a capital stock of $50,000. The incorporators are Warren E. Burns, of Philadelphia, Pa.; E. A. Lee, of St. Louis; Bertram Brown, of Glendale; G. W. Gan, of Waynesville, and J. J. Burns, of Webster Groves.

JEFFERSON CITY, MO.—Articles of association of the St. Joseph Belt & Interurban Railway Company have been filed with the Secretary of State with a capital stock of $1,500,000. The company has been organized for the purpose of constructing and operating a railway from St. Joseph to Savannah, a distance of 25 miles. The directors are: John Townsend, D. E. Heaton, Louis Huggins, D. B. Bartlett, J. S. Logan, J. H. McCord, J. A. Duncan, Robert Faucett, J. J. Peters, S. S. Brown, J. W. Brockett and J. E. Dolman.

FORSYTH, MONT.—The Sanders Howard Co-operative Ditch Company has recently been organized with a capital of $175,000 by J. W. Sweetser and Fred Herbold, both of Forsyth. The company is taking up a project once investigated by U. S. Reclamation Service, and contemplates a ditch system of 35 miles or more for irrigation and power purposes, and will be ready to advertise for bids on the construction early in 1907.

CARROLL, NEB.—A new telephone company has been organized here and will incorporate with a capital stock of $10,000. John Heeren is president.

DAVID CITY, NEB.—The David City Electric Manufacturing Company has been incorporated, with a capital stock of $50,000. The incorporators are: W. E. Butler, Morgan L. Lane and J. R. Evans.

OMAHA, NEB.—The Independent Telephone Company, with a capital of $2,000,000, has been incorporated. The incorporators are T. E. Parmele, T. H. Pollack, Stockton Heath, W. C. Bullard and F. W. Judson. The company was recently granted a franchise to operate a telephone system in the city.

CARSON CITY, NEV.—A company has been incorporated by T. B. Rickey, E. L. Wildes and P. V. Mighels to construct an electric railway in Carson City. The company is capitalized at $1,000,000. Mr. T. B. Rickey is one of the incorporators.

CAMDEN, N. J.—The Manufactures Fuel & Light Company has filed articles of incorporation, with a capital stock of $250,000. The incorporators are Charles R. Thomas, P. D. Harper and M. A. McKee.

KNOWLTON, N. J.—The Delaware & Belvidere Telephone & Improvement Company has filed articles of incorporation with a capital stock of $2,000, for the purpose of erecting and maintaining electric, telegraph and telephone lines in New Jersey. The incorporators are Charles J. Juigg, F. Brisbane, Michael C. Allen, George T. Prall, Jacob E. Albertson, John H. Albertson and Louisa R. Keinenour.

BROOKLYN, N. Y.—Articles of incorporation have been filed for the Bayley Lee Electric Company, with a capital of $15,000. The directors are G. W. Bayley, G. H. Bayley and N. H. Heim.

NEW YORK, N. Y.—Articles of incorporation have been filed for the Trumansburg Citizens' Telephone Company by R. J. Hunt and others. The capital stock of the company is $5,000.

SANDY HILL, N. Y.—The Fenimore Electric Light Company, of Sandy Hill, has been incorporated with a capital of $10,000, by James F. Bush, William H. Donaldson and Erskine C. Rogers, of Sandy Hill.

NEW YORK, N. Y.—The United Electric Service Company has filed articles of incorporation with the Secretary of State, with a capital stock of $5,000. The directors are M. W. Rayens, J. T. Mulhall and T. M. Henneberry.

CORTLAND, N. Y.—Articles of incorporation have been filed for the Oakland Electric Light & Gas Company with a capital stock of $50,000. The directors are Eugene Frost, W. H. Ash, of Cortland; L. T. Haney, of Brooklyn.

FULTON CHAIN, N. Y.—A certificate of incorporation has been filed by the Fulton Chain Electric Company, with principal office at Webb. The directors are Spencer Kellogg and others. The capital stock of the company is $5,000.

RAVENNA, N. Y.—The West Shore Electric Company has been chartered, with a capital stock of $40,000, to operate in Coeymans and New Baltimore. The directors are: John N. Briggs, Stephen W. Mosher, Coeymans, and William H. Baldwin, New Baltimore.

FORT MILLER, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Fort Miller Electric Light, Heat & Power Company, with a capital stock of $25,000. The directors are J. C. Harris, J. L. Henning, Jr., of Saratoga Springs, and J. J. Harris, of Fort Miller.

SYRACUSE, N. Y.—The Onondaga Lighting Company has filed articles of incorporation with the Secretary of State with a capital stock of $1,000,000. The directors are: L. Bedell Grant, and William J. Bagnell, of Brooklyn; Ashley T. Cole, Arthur McCausland and James A. Byrne, of New York City.

OLEAN, N. Y.—The Western New York & Pennsylvania Traction Company has been formed by the consolidation of the Olean Street Railway Company and the Bradford Street Railway Company. The company has a capital stock of $2,000,000, and the directors are Wilson R. Page, of Olean; Joseph B. Mayer and William F. Sheehan.

OLEAN, N. Y.—A certificate of merger of the Olean Street Railway and the Rock City Railroad Company, forming the Olean Street Railway Company, has been filed with the Secretary of State. The capital stock is $1,400,000, and the directors are James F. Johnson, M. L. Lee, Thomas Gilligan, I. W. Miller, W. R. Page, of Olean; W. B. Merser, of Portville; Charles Millard and Edward Tourney, of Allegany, and Julius C. Calisch, of Buffalo.

CRANDALL, OHIO.—Articles of incorporation have been filed for the Mutual Telephone Company with a capital stock of $5,000 by J. L. Walker and others.

YOUNGSTOWN, OHIO.—The Mahoning Valley Belt Line Railway Company has been chartered with a capital stock of $10,000. The incorporators are Harry G. Hamilton, Patrick I. McNally, and others.

MANCHESTER, OHIO.—The Citizens' Light Company, of West Manchester, has been incorporated, with a capital stock of $25,000, by John E. Leas, Bruce Hollman, Edward A. Lockel, J. Warren Sear and Charles A. Ford.

LANCASTER, OHIO.—The Lancaster Traction & Power Company has been chartered, with a capital stock of $400,000, to operate electric railways and furnish fuel, light and power in Lancaster and vincinity. The incorporators are Philip R. Peters and others.

CLEVELAND, OHIO.—The Cleveland, Alliance & Mahoning Valley Railroad Company has been incorporated to build an electric railway to connect Cleveland with Youngstown and a number of important points in Pennsylvania. The nominal capital stock of the company is $10,000, but this will be increased to $2,500,000 when it is financed. James W. Holcomb, of Cleveland, is one of the chief promoters, and it is said that J. R. Morley, president of the Stark Electric Company, is also interested.

OKLAHOMA CITY, OKLA.—The Deep Fork Telephone Company has filed articles of incorporation, with a capital stock of $5,000. The directors are J. T. Pierce and others.

TECUMSEH, OKLA.—The Tecumseh & Norman Traction Company has been chartered, with a capital stock of $1,000,000. The company proposes to construct an interurban line from Tecumseh to Norman, a distance of 34 miles.

OLUSTEE, OKLA.—The Olustee Telephone Company has filed articles of incorporation with a capital of $5,000. The incorporators are E. G. Walcott, T. I. Truscott, J. W. Edwards, D. W. Walden, W. T. Armstrong and T. R. Moore, of Olustee, and J. W. Weems, of Carmel.

PORTLAND, ORE.—The Western Electric Company has been incorporated with a capital stock of $50,000 by Charles H. Carey, Omar C. Spencer, and Roger B. Sinnott.

PORTLAND, ORE.—The Gordon Manufacturing, Power & Light Company has filed articles of incorporation, with a capital stock of $175,000. Sigmund Sichel is one of the incorporators.

ROSEBURG, ORE.—Articles of incorporation have been filed for the Myrtle Creek Water, Light & Milling Company, with a capital stock of $20,000. The incorporators are C. O. White, T. R. Sheridan and A. M. Kelsay.

BETHEL, PA.—The Blue Mountain Electric Company has been chartered, with a capital stock of $8,000.

HAZLETON, PA.—The Consumers Electric Light & Power Company has been organized, with A. W. Drake, president, and L. O. Emmerich, secretary. Work on the proposed electric light plant will soon begin.

NEW WILMINGTON, Pa.—The New Castle & New Wilmington Railway Company has been incorporated to build a railway to connect New Castle and New Wilmington, to be operated by electricity or gasoline power.

PHILADELPHIA, PA.—The Delaware Subway Company has been organized for the purpose of tunneling the Delaware River and constructing a railway between Philadelphia and Camden. The company is capitalized at $10,000.

HARRISBURG, PA.—A charter has been issued to the Ridgeway & St. Mary's Street Railway to construct a line 17 miles long in Elk County. The company is capitalized at $102,000. The incorporators are Harry C. Stackpole and others.

PENNSBURG, PA.—The Ledrachville & Pennsburg Electric Railway Company has been organized by interests controlling the Schuylkill Valley Traction Company, and will build a line connecting at Ledrachville with the line under construction from Trooper to Souderton.

PHILADELPHIA, PA.—In extending the territory of its subsidiary company, the Wilkesbarre & Wyoming Valley Traction Company, Interstate Railways interests have had incorporated the Wilkesbarre & Plains Street Railway Company (capital $24,000), and the Pittstown & Avoca Street Railway Company (capital $13,500).

NORRISTOWN, PA.—Charters have been placed on file in the Recorder's office for the Abington Light Company, the Moreland Light Company and the York Road Light Company. The incorporators of the above companies are Henry M. Blake, Jenkintown; Rydal and Robert D. Jenks, Philadelphia. Each company is capitalized at $5,000. The purpose of the incorporations is to furnish light, heat and power in the townships named.

COLUMBIA, S. C.—The Suburban Transit Company, Columbia, has been chartered to build numerous lines to new residence suburbs in Columbia. The scheme is backed by Julius Walker, president; J. S. Moore, vice-president, and B. W. Ravenel, secretary-treasurer. Several rights of way have been obtained.

PIERREPONT, S. D.—The Pierrepont Telephone Company has been incorporated with a capital stock of $10,000.

PIERRE, S. D.—Articles of incorporation have been filed for the North Star Telephone Company, at Beresford, with a capital of $25,000. The incorporators are August O. Roomison, Edward W. Owen, Andrew Johnson, A. H. Anderson.

SIOUX FALLS, S. D.—Articles of incorporation have been filed for the Sioux Falls & Sioux City Electric Railway Company with a capital stock of $1,000,000. The incorporators are: O. H. Smith, Charles Fantle, Fred C. Whitchouse, E. D. Morcom, J. W. Boyce, John A. Grose, and George W. Burnside, all of Sioux Falls.

NASHVILLE, TENN.—The National Power Company has been incorporated by J. E. Caldwell, D. C. Buntin and others, to transmit power from certain water falls in the Cumberland Mountains.

AUSTIN, TEX.—Articles of incorporation have been filed for the American De Forest Wireless Telephone Company of Texas by W. D. Hart and others. The company has a capital stock of $25,000.

BROWNSVILLE, TEX.—The Brownsville Water, Light & Power Company has been chartered with a capital stock of $100,000. The incorporators are James B. Wells, John G. Fernandez, F. Yturria, William Kelly and William Radcliffe.

KETTLE FALLS, WASH.—The Kettle Falls Power & Irrigation Company has been incorporated, with a capital of $500,000, to acquire water rights on Colville River or other rivers in Washington, to construct dams, reservoirs, canals, etc. It has purchased from J. W. Reynolds a power plant on Colville River, near Kettle Falls; also a grist and lumber mill. These mills will be enlarged, and an electric light plant will be installed to supply towns in the vicinity with electricity. It will also irrigate lands in this vicinity. The incorporators are: H. J. Cole and Charles V. Roberts, of Spokane, J. W. Reynolds, of Kettle Falls, and others.

PLEASANT SPRINGS, WIS.—Articles of incorporation have been filed for the Kegonsa Independent Telephone Company with a capital stock of $1,000 by Clarence Jordan and others.

MILWAUKEE, WIS.—The Plankinton Electric Light & Power Company has been incorporated with a capital stock of $50,000 by H. A. J. Upham, William Woods, Plankinton and George P. Miller. The company proposes to furnish light and heat on the west side of the city, and has applied to the City Council for a franchise for tunnel rights in that section of the city.

MINNEDOSA, MAN.—The Minnedosa Power Company has been formed here for the purpose of developing electric power in the Little Saskatchewan River. E. W. Pearson, G. A. Grierson, J. W. Thompson, J. S. Armitage and J. A. McIntyre, all of Minnesota, Man., are interested in the company.

Legal.

DYNAMO WINDING.—The General Electric Company, of Schenectady, N. Y., Nov. 19, brought suit against the Ford Oliver Electric & Manufacturing Company, of St. Louis, asking that the latter company be restrained from making a certain dynamo coil winding machines on the ground that they are infringing on the plaintiff's patents. The plaintiff company also asks that the extent of damages be ascertained and awarded them.

Obituary.

MR. A. V. ABBOTT.

MR. A. V. ABBOTT.—We regret to note the sudden death from pneumonia at St. Luke's Hospital, New York City, of Mr. Arthur Vaughan Abbott. He was born in Brooklyn, N. Y., in 1854, being a member of the well-known family of authors and clergymen bearing his name, and graduated from the Polytechnic Institute in 1875. He was connected after graduation with the construction of the East River bridge, and then became associated with the Daft Electric Light Company, participating in a great deal of its early construction of dynamos and motors and electric railways. In 1892 Mr. Abbott took up telephonic work on the staff of the Chicago Telephone Company, for whom by June, 1901, when he resigned, he had constructed twelve new office buildings with their equipments and lines. He had in the meantime done considerable electric lighting work. During the past few years, Mr. Abbott had been on the engineering staff of Westinghouse, Church, Kerr & Co., in New York City, doing also a great deal of work in the field. He was well known as a writer and author, his principal works being the well-known "Electrical Transmission of Energy," which has gone through several editions, here and in foreign languages, and a series of six volumes on "Telephony" issued by the McGraw Publishing Company, the bulk of the matter having appeared originally as articles in The Electrical World. Mr. Abbott was a member of a number of engineering bodies, including the American Institute of Electrical Engineers, American Society of Mechanical Engineers and the American Society of Civil Engineers. While gifted with inventive talent, though not in any marked degree, he had unusual skill as a designer and consulting engineer, and was a man whose friendship and acquaintance was esteemed throughout the profession.

Personal.

MR. H. M. LITTELL has resigned as vice-president and general manager of the San Antonio, Tex., Gas & Electric Company, and Mr. W. B. Tuttle has been elected as his successor.

MR. T. C. MAXFIELD has been placed in charge of the New York office of the Weber Steel-Concrete Chimney Company, of Chicago, vice Mr. Hill, who is no longer connected with the company.

MR. V. C. GILPIN, 120 Liberty Street, New York City, has been appointed to succeed Mr. W. J. Bramhall as New York representative of the Steel City Electric Company, of Pittsburg. Mr. Gilpin will have charge of sales in New York and vicinity and will carry a large stock of apparatus to insure prompt execution of orders from local customers.

MR. W. SMITH HORRY.—The Gas & Electric Development Company, of Philadelphia and New York, reports the sale of the Home Electric Company, of Guttenberg, Ia., to Wm. Smith Horry, of Niagara Falls, N. Y. Mr. Horry has assumed control of the company. He has been prominently connected with electrical enterprises for many years.

MR. C. H. H. STONE.—The chairman of the New York State Commission of Gas and Electricity has announced the appointment of Charles H. H. Stone to be chief inspector in the department at a salary of $150 a month. Mr. Stone is now a resident of Albany, although he had been engaged as an expert by the Massachusetts Lighting Board. He succeeds Chief Inspector Dailey, who resigned.

MR. WALTER C. KERR has been appointed by Mayor McClellan of New York member of a commission to revise the rules and regulations of city departments as to permits, etc., for storage of building material in the streets. The commission is the outcome of widespread complaints against the blockading of streets with building material. There is a possibility that before the work of the commission is completed there may be enough developments to justify the creation of a new department to handle just such problems.

MR. W. H. BROWNE has opened offices at 34 Pine Street, New York City, for electrical work, including the supervisory administration and management of several plants. He has resigned as director, treasurer and general manager of the Stanley Instrument Company, of Great Barrington, with which he was associated from January, 1902. Since 1886, Mr. Browne has been active in the electrical field. In that year he began with the organization and building of the electric railway and lighting plants at Richmond, Va., and he was associated with those interests until 1889. From May, 1888, until July, 1894, he was general manager of the United Electric Light & Power Company, of New York City. He then became receiver of the Flushing & College Point Railroad, Long Island, and from 1895 to 1902 was general manager of the Royal Electric Company, of Montreal, Can.

Trade Publications.

SINGLE-PHASE MOTORS.—Bulletin No. 7 of the Century Electric Company, 404 North 4th Street, St. Louis, Mo., deals with a line of self-starting, single-phase induction motors varying in ratings from ¼ to 5 hp for frequencies of from 25 to 133 cycles.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is sending out to the trade circulars and bulletins descriptive of the Columbia incandescent lamp for which it is sales agent. The Columbia lamp is well and favorably known and as this is the time of the year when the majority of lamp contracts are made, it is suggested that consumers write the Central Electric Company for their yearly contract plan. The company believes that it has a money-saving proposition and will be pleased to submit it to any one interested.

News of the Trade.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, through its Chicago office, has contracted with the Shepherd Engineering Company, of Franklin, Pa., to furnish an engine-type Triumph generator for the city of Chicago, this machine to be used for lighting the city pumping station at Fourteenth Street.

THE CENTRAL LABORATORY SUPPLY COMPANY, of Lafayette, Ind., announces that it has secured the exclusive rights to manufacture the recording apparatus invented by Prof. C. E. Vawter. The instrument has been adapted to use with pyrometers, resistance thermometers and speed-recording devices. Descriptive bulletins may be had upon request. The instrument was described recently in these pages.

ELECTRIC CABLE COMPANY.—The Armory of the Twenty-third Regiment, N. G. S. N. Y., in Brooklyn, has been treated with Voltax liquid compound, which is now being extensively used as a waterproofing and fireproofing material. This liquid compound has only recently been placed on the market by the Electric Cable Company, of 17 Battery Place, New York, which has made a number of large sales of this material, both as a colorless and a colored compound to replace the ordinary waterproofing paints.

THE BLAKE SIGNAL & MFG. COMPANY, 246 Summer Street, Boston, Mass., advises us as follows: "Referring to the Climax soldering flux tube, which was formerly put up by the Climax Manufacturing Company, No. 1 Hartford Street, Boston, Mass., we are pleased to advise that we have taken over from the Climax Mfg. Co. all patent rights, good will, etc., so far as the soldering flux tube is concerned, and will put this product out in connection with our other Blake patents as the "Blake Tube Flux." We have improved slightly the quality of the tube, and are prepared to fill all orders promptly, to push the sale energetically of this, the best and most convenient and economical soldering flux on the market.

THE ONEIDA COMMUNITY, LTD., Oneida, N. Y., calls attention to its Oneida galvanized chain as the only suspension which will not freeze in the pulleys or in other ways give trouble in raising and lowering arc lamps during ice and sleet storms. The jointed links aided by the weight of the lamp pass readily through the pulleys, breaking any ice or sleet that may adhere to the chain. This was very strikingly demonstrated at Niagara Falls where certain lights were close to the Cataract, and the chain was subjected not only to all conditions of weather, but to a continuous deposit of mist arising from the Falls. The Buffalo & Niagara Falls Electric Company reports that the chains on this system work perfectly throughout the entire winter in spite of the severe conditions.

JOHNS-MANVILLE.—The Boston branch of the H. W. Johns-Manville Company will move, early in December, into a new building at Nos. 55-57-59 High Street, Boston. This entire building, which comprises seven floors, will be occupied by the offices, sales and shipping rooms of the company, and will provide every facility for doing business comfortably, conveniently and promptly. Telephones connect with every division of the establishment and pneumatic tubes for prompt delivery of orders to the shipping room, etc., are being installed. The increase of space provided will enable the company to carry a much larger stock on hand than ever before and thus meet the steadily increasing demand in the city and vicinity of Boston, and the New England States, for the various products of the company.

NEW YORK ELECTRIC CONTROLLER COMPANY, 21-27 Chambers Street, New York, manufacturer of automatic electric controlling devices, reports a steadily growing demand for and great success with its apparatus. The devices which it makes a specialty of were developed and put in use two years ago and they were so successful in operation that the company is now receiving reorders from the same customers. The elevator controller works perfectly on any kind of a motor-driven elevator, and is safe and sure in its action. The motor controllers permit the stopping and starting of the motors from any number of points by means of any ordinary snap switch carrying 1-10 ampere of current. This means a great saving in current consumption as the motor is so easily started and stopped that the employees do not keep it running when not actually needed, and electrical troubles due to use of hand rheostat and switch are entirely eliminated. The wiring is simple and inexpensive.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 27, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

836,666. ELECTRIC CONTROLLER; Roy W. Brown, Amsterdam, N. Y. App. filed Jan. 23, 1906. A plurality of contacts are contained in separate chambers vertically above one another in a casing, and a cam operated rod extends vertically through all of the chambers, and is adapted to move brushes successively to close the circuits.

836,668. OPERATOR'S KEY; Albert Carliss, Chicago, Ill. App. filed Apr. 1, 1901. Mechanical details of operator's key having two insulating rollers which may be swung into engagement with spring blades to close the operator's ringing or telephone circuit.

836,674. SOUND-SENSITIZER; Marcus Frank, Cincinnati, O. App. filed Sept. 13, 1906. In combination with a sound-receiving instrument, a sensitizer composed of a feather media inclosed in a fabric of a size adapted to cover the mouth of the receiver on one side, and to cover the organ of the ear with the other side, substantially as described.

836,724. SHIP'S PROGRESS INDICATOR; Thomas Whittle Prahran and William Cummings, Malvers, Victoria, Australia. App. filed July 18, 1905. A board having a map thereon is slotted along the path of the ship's course and miniature ships may be moved in the slot by a chain through an electric motor controlled from a distant point.

836,794. AUTOMATIC DEVICE FOR OPERATING VALVES AND OTHER MECHANISMS; Oscar Winter and Fred. W. Waterman, Elyria, O. A magnet trips a weighted arm from its position near one of unstable equilibrium, so that the arm swings down and impinges against another trip or detent acting to close the valve.

836,805. TELEPHONE OR SWITCHBOARD PLUG; Alva B. Dozier, Taylor, Tex. App. filed May 10, 1904. In a device of the character described, the combination of a semi-cylindrical casing, integral resilient jaws secured thereto, said jaws provided with toothed, inner and screw-threaded outer surfaces, and an adjusting-nut removably mounted upon said jaws.

836,827. CIRCUIT CONTROLLER; James P. Poole, New York, N. Y. App. filed June 13, 1905. Relates to electric pianos, and has a cylinder with contacts so arranged that when the cylinder is angularly moved the piano keys operate different sets of hammers, so that the key of the composition is changed.

836,848. TELEPHONE APPARATUS; David H. Wilson, Chicago, Ill. App. filed Dec. 8, 1902. An induction-coil comprising a core formed so as to have separated, opposed poles, an angularly-projecting pole-piece on each of said poles and a telephone receiving-diaphragm associated with said pole-pieces so as to be actuated thereby, a supporting part for said diaphragm carried by the core of the induction-coil.

836,863. PROCESS OF MAKING ELECTRIC CONDENSERS; Henry P. Clausen, Chicago, Ill. App. filed Feb. 2, 1903. A sheet of tin foil is led through a paraffine bath between paper strips and the resulting rolls are flattened and boiled in paraffine.

836,895. ELECTRIC BLOCK SIGNAL; Walter E. Sands, Brooklyn, N. Y. App. filed Dec. 29, 1905. Track rails are divided into sections and a depending rod from the car is also provided to pass between spring plates, sets the signals, and also operates an alarm device beside the track of the block in which the train is passing.

836,904. AUTOMATIC SYSTEM OF INTERCOMMUNICATION; Anthony Van Wagenen, Sioux City, Ia. App. filed July 31, 1902. A telephone system having dials at the subscribers' stations by which intermittent currents may be produced so as to step around the switch arms at the automatic central station.

836,936. TEMPORARY TELEGRAPH STATION; Charles S. Maynard Chardon, O. App. filed Sept. 24, 1906. Provides switches in the telegraph lines to open them and bridges a temporary set across the two line wires between switches opened on the respective wires.

836,965. ELECTRIC DOOR OPENER; Edwin W. Fyler, Hyde Park, Mass. App. filed Apr. 9, 1906. Designed to provide a compact arrangement. The latch is spring impelled into closing relation, but may be opened by the pressure of the door when an abutment moved by an electromagnet is displaced.

836,973. SYSTEM OF MOTOR CONTROL; George H. Hill, Schenectady, N. Y. App. filed May 20, 1905. The controller has an engineer's valve adapted to control the ports of a pair of small pistons in the controller which move the sliding valves for the pilot train pipe pressure.

836,974. METER; Frank Holden, Rugby, England. App. filed Apr. 24, 1905. The magnet has a narrow chamber in its field with mercury therein and the moving element in such chamber has a plurality of conductors which move in proximity to stationary conductors in the walls of the chamber.

836,978. ALTERNATING-CURRENT MOTOR; Marius C. A. Latour, Paris, France. App. filed May 16, 1905. In an alternating-current dynamo-electric machine, an armature having a plurality of separate windings connected to successive commutator-segments, connections between a plurality of equipotential points on said windings, and commutator-brushes of a width insufficient to bridge adjacent segments connected to the same winding.

836,981. TRAIN CONTROL SYSTEM; Charles E. Lord, Cincinnati, O. App. filed Oct. 1, 1904. Has a pneumatic actuating system for controlling the contactors and a separate pneumatic system for maintaining contacts after they have been actuated.

836,994. INTERLOCK FOR ELECTRIC SWITCHES; Oran O. Rider, Schenectady, N. Y. App. filed Sept. 28, 1905. Has means for insuring the restoration of the switch last operated before the next switch can be moved.

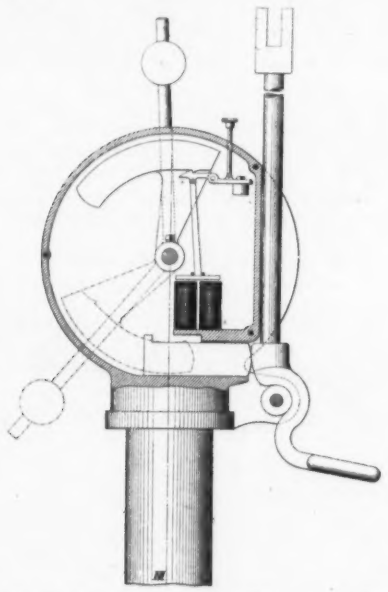
836,998. ALTERNATING-CURRENT MOTOR; Ernest Schweiger, Schenectady, N. Y. App. filed May 2, 1904. Has an auxiliary stator winding in series with one of the main windings and an auxiliary rotor winding in inductive relation to said auxiliary stator winding.

837,022. SAFETY APPARATUS FOR RAILWAYS; Granville T. Woods and Lyates Wood, New York, N. Y. App. filed Oct. 5, 1904. A pneumatic control system in which the controller must be operated in a predetermined way so that in case of any irregular movement caused by the death or incapacity of the motorman, the train would be instantly stopped.

837,023. CIRCUIT BREAKER; Gilbert Wright, Pittsfield, Mass. App. filed Jan. 11, 1904. A knife blade switch is spring impelled to open the circuit and normally restrained by a trip which is impinged by the armature of a solenoid magnet.

837,033. COOLING DYNAMO ELECTRIC MACHINES; Paul Bunet, Paris, France. App. filed Mar. 23, 1905. The commutator segments have radially projecting bars or extensions therefrom which move in annular chambers so as to establish a cooling air current and keep the segments cool.

837,037. MOTOR CONTROL APPARATUS; Frank E. Case, Schenectady, N. Y. App. filed Apr. 17, 1905. Has an electromagnetically



836,794.—Automatic Device for Operating Valves and Other Mechanisms.

actuated contact and a pneumatically actuated contact and a valve associated with the first contact for controlling the latter contact.

837,044. TESTING DEVICE; Alvarado L. R. Ellis, Lyon, Mass. App. filed Oct. 23, 1905. An arrangement for testing the magnets of motors by balancing their damping effect on a metallic disc against the damping effect of another similar standard magnet. The discs are actuated by differential gearing so that their speed difference is constantly indicated.

837,054. CONSTRUCTION OF INCANDESCENT ELECTRIC LAMP SOCKETS; Gilbert W. Goodridge, Bridgeport, Conn. App. filed Apr. 9, 1906. The case of the lamp socket has a form of pin and slot engagement in which the pins have to be depressed against springs before the parts can be separated.

837,055. CONSTRUCTION OF INCANDESCENT ELECTRIC LAMP SOCKETS; Gilbert W. Goodridge, Bridgeport, Conn. App. filed Apr. 9, 1906. Relates to modifications of the above.

837,066. METER; Frank Holden, Rugby, England. App. filed Nov. 17, 1905. Has a shell revolving in a mercury bath between magnetic poles. Relates to details of construction.

837,073. INCANDESCENT LAMP SOCKET; William W. Jones, Bridgeport, Conn. App. filed May 12, 1906. The parts of the lamp socket casing are fastened together by a bayonet joint and also by a spring tongue so as not to become accidentally dislodged.

837,083. PROCESS FOR THE MANUFACTURE OF GLYCOLIC ACID; Otto Liebknecht, Frankfort-on-the-Main, Germany. App. filed June 14, 1906. Utilizes the electrolytic reduction of oxalic acid in the cathode compartment of an electrolytic apparatus in the presence of lead electrodes.

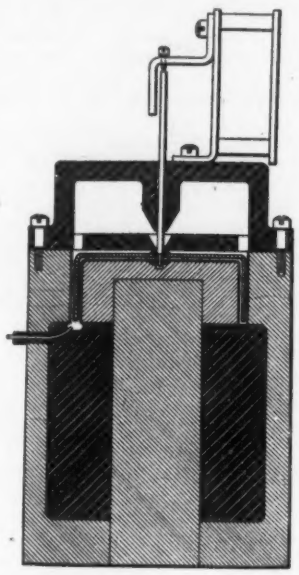
837,084. APPARATUS FOR ILLUMINATING PHOTOGRAPHIC STUDIOS WITH ELECTRIC INCANDESCENT LAMPS; Philipp G. Von Der Lippe, Vienna, Austria-Hungary. App. filed Jan. 9, 1906. A miniature traveling crane is provided with depending cords which support the horizontal tubes of a mercury vapor lamp.

837,092. CIRCUIT BREAKER; William Merrill, Wilmington, Del. App. filed Oct. 19, 1905. A tube containing a viscous fluid is supported on trunnions so as to tilt under the influence of a magnet. Has a ball therein so as to keep the tube tilted in case the magnet operates more than a predetermined length of time.

837,097. ELECTRIC ALARM; Ernest S. Moorer, Anderson, S. C. App. filed Sept. 16, 1905. Has a heat controlled member or thermostat in a telephone circuit so as to give an alarm over the usual wires in case of fire.

837,107. APPARATUS FOR THE STERILIZATION OF WATER BY MEANS OF AN ELECTRIC CURRENT; Marius Otto, Paris, France. App. filed July 1, 1904. In an apparatus for sterilizing water by ozone, the combination with an ozone-producer, water-supply, a cylinder, and a piston therein adapted to control by its movement the production of ozone and the supply of water to be sterilized; of automatic means for admitting water under pressure to said cylinder to cause said piston to move.

837,154. RAILWAY SIGNALING SYSTEM; Louis H. Thullen, Edgewood Park, Pa. App. filed May 22, 1905. Relates to a plan of impressing a special pulsating current on the track rails of an alternating current



836,974.—Meter.

transit system so as to avoid the operation of the signals by the power current.

837,174. LIFTING-MAGNET; Charles E. F. Ahlm, Cleveland, O. App. filed May 22, 1906. The lifting magnet has a plurality of tiers or shelves on its inside annular surface and separate coils are included therein so as to produce a succession of annular pole faces.

837,178. AUTOMATIC CIRCUIT CLOSER; Tully W. Benson, Wewoka, I. T. App. filed Jan. 4, 1906. A device for insuring the closure of a telegraph circuit after a certain interval even if an operator leaves his key open. Has clock-work which is automatically started to close the circuit whenever a message is sent, and which acts after a certain time interval in case the usual switch is left open.

837,182. ATTACHMENT PLUG FOR ELECTRIC LIGHTING; David E. Brown, Pittsburg, Pa. App. filed Aug. 14, 1905. The plug is made of an integral piece of porcelain and is longitudinally and transversely channeled to receive clips which form the circuit terminals.

837,183. FUSE PLUG FOR ELECTRIC LIGHTING; David E. Brown, Pittsburg, Pa. App. filed Aug. 14, 1905. Relates to a form of fuse plug having an integral piece of porcelain channeled to receive the fuse wire in a circuitous path.

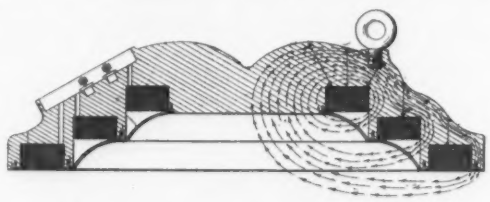
837,184. ATTACHMENT PLUG; David E. Brown, Pittsburg, Pa. App. filed Nov. 6, 1905. An attachment plug having a threaded shell and having a central removable jack.

837,185. AERIAL CABLE SUPPORT; Charles L. Brown, Philadelphia, Pa. App. filed July 21, 1905. A piece of wire is bent with hooks at its ends to surround a messenger cable and a central loop to hold the conductor.

837,213. ELECTRIC MOTOR; Manes E. Fuld, Baltimore, Md. App. filed Feb. 6, 1906. Relates to miniature motors and particularly the support of the spring brushes thereof designed to use metallic stampings.

837,227. RAILWAY SIGNALING SYSTEM; Joseph H. Horazdovsky, Cleveland, O. App. filed May 21, 1906. A supplemental rail is supported against the usual rail so as to be displaced by the flanges of the locomotive wheels. Closes an alarm circuit by its displacement.

837,231. SYSTEM OF ELECTRIC REGULATION; Joseph Bijur, New York, N. Y. App. filed Feb. 17, 1905. A special form of regulator



837,174.—Lifting Magnet.

has an armature which moves against a weighted cord. The movements of the armature insert resistance so to keep the load on the charging dynamo constant.

837,241. ELECTRIC SWITCH; William J. Murray, Leavenworth, Kan. App. filed May 2, 1905. A snap switch in which the blades are impelled through intermediate balls, which cause an abrupt movement for a certain angular throw of the actuating part.

837,249. APPARATUS FOR MAKING WELDS; John C. Perry, La Junta, Col. App. filed July 16, 1904. Has a plurality of self-adjusting electrodes combined with means for equalizing the pressure applied simultaneously through said electrodes.

837,251. TELEPHONE APPARATUS; Homer J. Roberts, Evanston, Ill. App. filed Sept. 18, 1902. Relates to details of a party line telephone system.